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EVALUATED NUCLEAR STRUCTURE DATA FILE

A Manual for Preparation of Data Sets

J.K. Tuli

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NATIONAL NUCLEAR DATA CENTER

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I. INTRODUCTION

This manual[1] describes the organization and structure of the Evaluated Nuclear Structure Data File (ENSDF). This computer-based file is maintained by the National Nuclear Data Center (NNDC) at Brookhaven National Laboratory for the international Nuclear Structure and Decay Data Network.[2]

For every mass number (presently, $A \leq 263$), the Evaluated Nuclear Structure Data File (ENSDF) contains evaluated structure information. For masses $A \geq 45$, this information is documented in the *Nuclear Data Sheets;* for $A<45$, ENSDF is based on compilations published in the journal *Nuclear Physics.* The information in ENSDF is updated by mass chains with a present cycle time of approximately six years.

The author gratefully acknowledges many suggestions and comments received during the revision of this manual. Special thanks are due to M. J. Martin (ORNL), R. B. Firestone (LBL), and the following colleagues at NNDC: S. Pearlstein, M. R. Bhat, T. W. Burrows, and R. R. Kinsey. This research was supported by the Office of Basic Energy Sciences, U. S. Department of Energy.

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[1]The format for ENSDF was first designed by W. B. Ewbank and M. R. Schmorak at the Nuclear Data Project, Oak Ridge National Laboratory, and was described in the Rept ORNL-5054/R1 (February 1978). The present report describes the current format and supersedes both the ORNL report and the Report BNL-NCS 51655 (March 1983) by J. K. Tuli.

[2]Coordinated by the International Atomic Energy Agency, Vienna—see Appendix E for list of evaluation centers.

II. GENERAL ORGANIZATION AND STRUCTURE OF THE DATA FILE

A. General Organization

The Evaluated Nuclear Structure Data File (ENSDF) is made up of a collection of “data sets” which present one of the following kinds of information:

1. The evaluated results of a single experiment, e.g., a radioactive decay or a nuclear reaction.
2. The combined evaluated results of a number of experiments of the same kind, e.g., (Heavy ion, xnγ), Coulomb excitation, etc.
3. The adopted properties of the nucleus.
4. The references used in all the data sets for the given mass number. This data set is based upon reference codes (key numbers) used in various data sets for a given mass number and is added to the file by NNDC.
5. The summary information for a mass chain giving information, e.g., evaluator’s name and affiliations, cutoff date, *Nuclear Data Sheets* publication details, etc.

The data sets in ENSDF are organized by their mass number. Within a mass number the data sets are of two kinds:

i. Data sets which contain information pertaining to the complete mass chain. These data sets contain information of the type (4) and (5) given above.

ii. Data sets belonging to a given nucleus (Z-value)

Date sets (ii),i.e. for a given nucleus (Z-value) consist of the following:

a. Adopted data set (only one per Z-value) giving adopted properties of the levels and radiations seen in that nucleus.

b. Data sets giving information of the type (1) or (2) above.

If there is more than one data set of type (1) or (2) for a given nucleus, then an adopted data set is *required* for that nucleus. If there is only one data set for a given nucleus, then that set is assumed also to present the adopted properties for that nucleus.

The general organization of ENSDF is shown schematically in Figure 1.

Evaluated Nuclear Structure Data File

Organization Chart

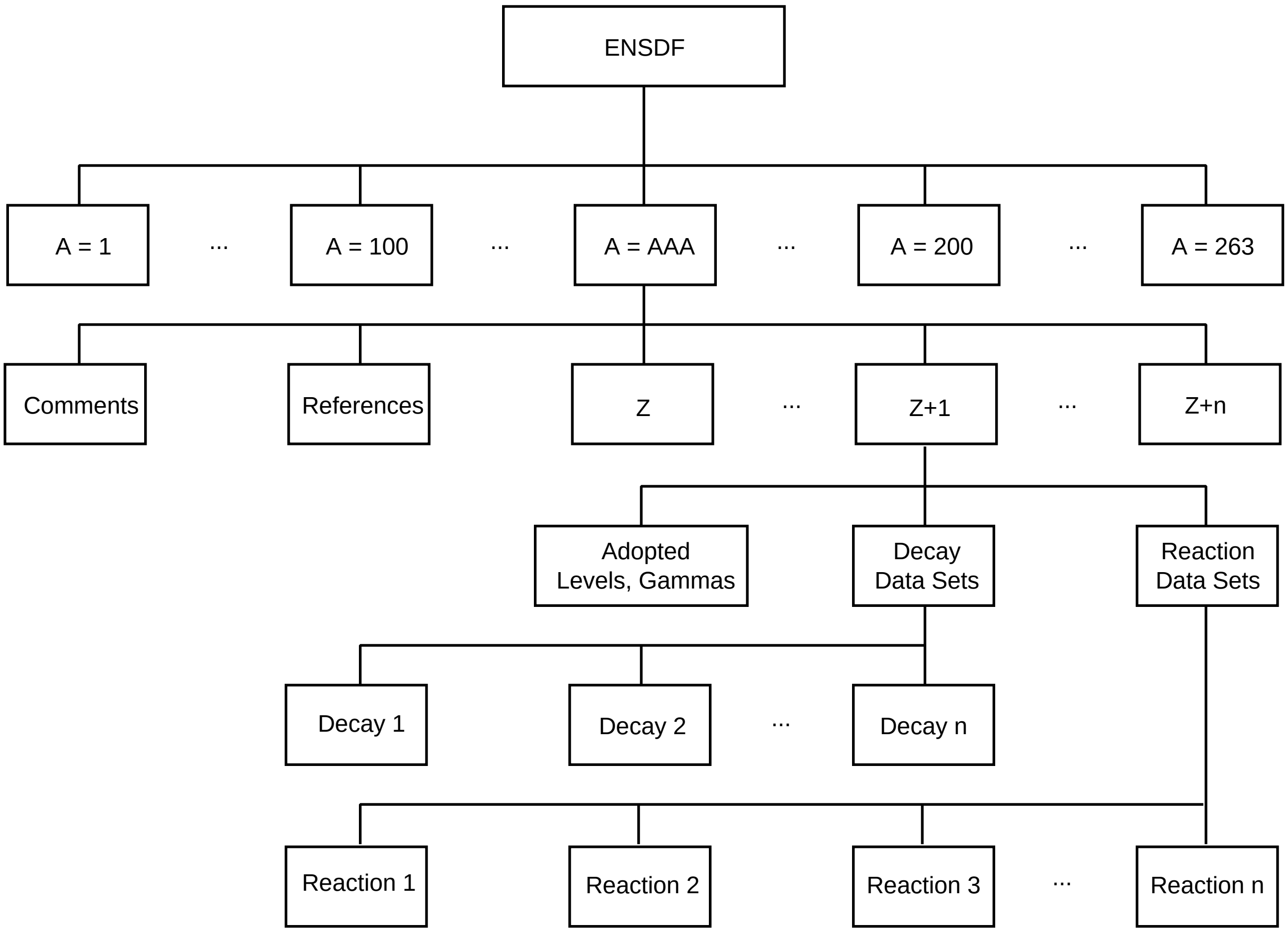


Figure 1.

Data Set Structure

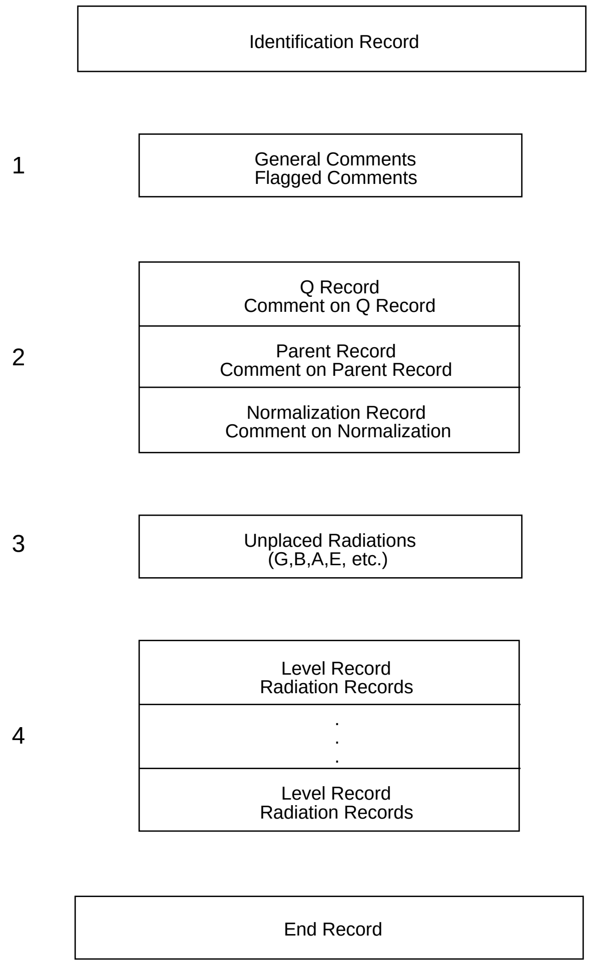


Figure 2.

B. Data Set Structure

A data set is composed of records, each record is made up of one or more 80-column card images. Data set structure is given in Figure 2 and is described below:

A data set *must* begin with an **IDENTIFICATION** record and *must* end with an **END** record (a blank card). Between these two records, there can be as many additional records as are needed to describe fully the experimental or the evaluated data.

Immediately following the **IDENTIFICATION** record is a group of records which contain information about the entire data set (#1 and #2 in Figure 2). The general **COMMENT** (**C), NORMALIZATION (N), Q-VALUE (Q), PARENT (P), and CROSS-REFERENCE (X)** records are of this type. Not all of these records are included in every data set. For example, **Q-VALUE (Q) and CROSS-REFERENCE (X)** records normally appear only in adopted data data sets, while the **PARENT (P)** record is given only in radioactive decay data sets.

The body of a data set (#3 and #4 in Figure 2) is composed of numeric data records which describe the measured or deduced properties of levels, γ rays, α particles, etc. These records are associated with the level which decays (for **GAMMA** records) or the level which is populated (for **BETA, EC, ALPHA,** or **DELAYED-PARTICLE** records). Thus, each **LEVEL** record is followed by a group of records describing β, ε, or (delayed-) particle decay into the level and γ-ray out of the level (#4 in Figure 2). The **LEVEL** records, and the corresponding radiation records, are placed in the data set in order of increasing energy.

If a **GAMMA, ALPHA, EC**, or **BETA** record properly belongs in a data set but cannot be associated with any particular level, then the record should be placed in the data set *before any* **LEVEL** records (#3 in Figure 2).

The placement of **COMMEN**T records is described in Chapter III.

C File Storage and Transmittal

The data sets*f* sent to NNDC for inclusion in ENSDF can be in any order, as the file is stored in a direct access mode (by data sets) using a data base management system. Copies of the file are transmitted in the form of a sequential file on magnetic tape. The data sets in the sequential file are arranged by mass numbers in increasing numerical order. For a given mass number the data sets are organized as given in Figure 1, ordering them from left to right. Decay data sets are placed under the daughter nucleus and are ordered by A, Z and then the excitation energy of the parent nucleus. The reaction data sets are given under the residual nucleus and are ordered by the A, Z of the target nucleus follwed by the A, Z of the incident particle and then by the energy of the incident particle.

III. STANDARD ONE-CARD RECORD FORMATS

A. Introduction

In most cases, all information for a record can be placed on a single 80-column card. A "standard" format has been defined for each one-card record, such that the most commonly used quantities can be placed on a single card. The standard formats are described in this section for each record. If a needed quantity is not included in the standard format or if a value will not fit within the field defined for the value by the standard format, or if a record cannot be contained on a single card, then additional cards can be prepared as described in Chapter IV (for examples, see Appendix C). Note that many of the analysis programs, at present, do not process standard fields when placed on the continuation cards.

B. The Standard One-Card Record Formats

Record formats are given below in the same order in which they would normally be encountered in a data set. Conditions under which each record may appear or be required are given in parentheses. The format descriptions give the fields (in inclusive card-column numbers), the field names (the formal "name" of the quantity that goes into the field), and a brief field description. Card columns not explicitly included in the fields are expected to be blank. A detailed description of each field can be found in the reference section noted. (Any numerical field left blank usually implies that the numerical information is lacking. Numbers will usually be assumed to be positive unless stated otherwise.) Numbers can be entered anywhere in the appropriate field (i.e., there is no need to left-adjust or right-adjust.)

1. THE IDENTIFICATION RECORD

(Required for all data sets. Must precede all other records.)

Field(Col.)	Name	Description	Reference
1-5	**NUCID**	Nucleus identification	**V.1**
6-9		Blank	
10-39	**DSID**	Data set identification	**V.2**
40-64	**DSREF**	References to main supporting publications and analyses	**V.3**
65-74	**PUB**	Publication information	**V.4**
75-80	**DATE**	The date (year/month/day) when the data set was placed in ENSDF (entered automatically by computer)	**V.5**

Note: In the rare case when the DSID field is insufficient for dataset identification, it may be continued on a second identification record with columns 1-39 defined as above, except that column 6 will contain an alphanumeric character and columns 40-80 will be blank.

2. THE Q-VALUE RECORD

*(Required for adopted data sets. If there is only one data set for the nuclide, then the Q-value record should be given in that data set. Must precede **L, C, B, E, A, DP** records. If signs are not given, they are assumed to be positive.)*

Field(Col.)	Name	Description	Reference
1-5	**NUCID**	Nucleus identification	**V.1**
6		Blank	
7		Must be blank	
8	**Q**	Letter '**Q**' is required	
9		Must be blank	
10-19	**Q$^-$**	Total energy (keV) available for β^- decay of the ground state. ($Q^->0$ if β^-decay is energetically possible. **Q$^-$**<0 represents the Q_ε energy of the Z+1 (Z = proton number) isobar.)	**V.10**
20-21	**DQ$^-$**	Standard uncertainty in **Q$^-$**	**V.11**
22-29	**SN**	Neutron separation energy in keV	**V.10**
30-31	**DSN**	Standard uncertainty in **SN**	**V.11**
32-39	**SP**	Proton separation energy in keV	**V.10**
40-41	**DSP**	Standard uncertainty in **SP**	**V.11**
42-49	**QA**	Total energy (keV) available for α decay of the ground state	**V.10**
50-55	**DQA**	Standard uncertainty in **QA**	**V.11**
56-80	**QREF**	Reference citation(s) for the Q-values	**V.3**

3. THE CROSS-REFERENCE RECORD

*(Given only in adopted data sets. Must precede **L, G, B, E, A, DP** records.)*

Field(Col.)	**Name**	**Description**	**Reference**
1-5	**NUCID**	Nucleus identification	**V.1**
6		Blank	
7		Must be blank	
8	**X**	Letter 'X' is required.	
9	**DSSYM**	Any **ASCII** charactor that uniquely identifies the data set whose **DSID** is given in columns 10-39.	
10-39	**DSID**	*Must exactly match one of the DSIDs used.*	**V.2**
40-80		Blank	

Note: In the *Nuclear Data Sheets* the DSID on the first 'X' record in the data set will be identified with character 'A', and second DSID with 'B', and so on, irrespective of DSSYM on the X card. Only the first 14 DSIDs on 'X' records are given different symbols. All the rest are given the symbol 'O' (for others). By merely reshuffling the X records, evaluators can ascertain the DSIDs that will be identified individually. This has no effect on the file and affects only the published output.

4. THE COMMENT RECORD

i. General Comments

*(Must precede all **L, C, B, E, A, DP** records.)*

Field(Col.)	**Name**	**Description**	**Reference**
1-5	**NUCID**	Nucleus identification	**V.1**
6		Blank, Any alphanumeric character other than '1' for continuation records	
7	**C**	Letter 'C', 'D', or 'T' is required *(see notes 3 – 5 below)*	
8	**RTYPE**	Blank or type of records to which the comment pertains	**V.6**
9		Blank, or symbol for a particle, e.g., N, P, etc.	
10-80	**CTEXT**	Text of the comment [See ENSDF Translation Dictionary (Appendix D)]	**V.7**

NOTES:

1. The comment refers only to records of specified **RTYPE** given in that data set. The comment will normally appear only in the table for that **RTYPE** in the output. For example, if the comment is on levels ('L' in column 8) it will appear only in the level properties table.
2. If column 8 is blank, then the comment refers to the whole data set. In the case that **NUCID** contains only the mass number (columns 4-9 blank), the comment refers to the whole mass-chain A.
3. Letter 'T' in place of 'C' in column 7 of a comment record indicates to the output programs that this record should be reproduced "as is" and the blanks in the record should not be squeezed out. *See examples in Appendix C.*
4. Letter 'D' in place of 'C' in column 7 of a comment record indicates to the output programs that this is a documentation record and should be ignored. This record will also be ignored by the various analysis programs.
5. Lower case letters 'c' and 't' in column 7 of a comment record indicate to the output programs that CTEXT in these records should not be translated. These will appear as written in the *Nuclear Data Sheets*. In this mode one can write special characters directly, for example, "|g" for γ, "{+238}Pu" for ^{238}Pu. See Appendix A for list of special characters.

ii. Record Comments

(Must follow the record to which the comment pertains)

Field(Col.)	Name	Description	Reference
1-5	**NUCID**	Nucleus identification	**V.1**
6		Blank, Any alphanumeric character other than "1" for continuation records	
7	**C**	Letter 'C' or 'D' is required. *See notes 4 and 5 in the section on General Comments.*	
8	**RTYPE**	Record type being commented upon	**V.6**
9	**PSYM**	Blank, or symbol for a particle, e.g., N, P, etc.	
10-80	**SYM$** or **SYM,SYM,…$**	**SYM** = type of data being commented upon.Specified **SYM**s *must be followed by a "$" except as in note 1 below.*	**V.8**
10-80	**CTEXT**	Text of comment follows the '$'. On continuation comment records, **CTEXT** may start in col. 10, and **SYM** or **SYM**s are not repeated. [See , ENSDF Translation Dictionary. (Appendix D)]	**V.7**

NOTES:

1. The old format, where **SYM**s were specified in columns 10-19, will be accepted without the '**$'** delimiter as long as column 19 is a blank. In this case comment text begins in column 20.
2. Record comments placed following a record of the same **RTYPE** <u>refer only to that one record.</u> (For example, a comment record with "CL" in columns 7-8 and "T$" in columns 10-11 placed following the level record for the second-excited state refers only to the half-life of the second-excited state.)

iii. Footnote Comments

*(Must precede **L, C, B, E, A, DP** records)*

Field	Name	Description	Reference
1-9		same as in ii (record comments)	
10-80	**SYM$ or** **SYM,SYM,...$** or **SYM(FLAG) $ or** **SYM(FLAG)**. **SYM(FLAG),…$**	**SYM** = see note 1 below; **FLAG** = any ASCII alphanumeric character or string of alphanumeric characters *Field must end with a "$" --* *See note 1 on Record comments for exception*	**V.8**
10-80	**CTEXT**	Text of comment follows "$" On continuation comment records **SYM** or **SYM(FLAG)** are not repeated. [See ENSDF Translation Dictionary (Appendix D)]	**V.7**

NOTES:

1. **SYM** can be only one of the following:
   –The fields defined in formatted **L, C, B, E, A, DP** records.
   –TITLE—*see note 2 below*. **FLAG** with this **SYM** is not allowed.
   –BAND—this **SYM** must be accompanied by a **FLAG.** Note also that text following '$' delimiter, or in columns 20-80 in old format, will appear as the band label in the drawing. Any other information on that band should, therefore, be given on continuation records.
   –CONF—same as BAND except that **FLAG** is optional. Without the given configuration comment will apply to all levels.**FLAG**
2. <u>Footnote without **FLAG**</u>
   –This refers to all records of the specified **RTYPE** in the data set.
   –The footnote will normally appear only in the table for that **RTYPE** in the output. For example, if the footnote is on levels ('L' in column 8) it will appear only in the level properties table.
   –If the word "TITLE" was used as **SYM** the footnote will apply to the table heading.
3. <u>Footnote with **FLAG**</u>
   –Only those records are footnoted for which footnote flags are given, see note 4 below.
   –Only those data values of data types specified by **SYM** which is associated with a given **FLAG** are footnoted.

4. Footnote **FLAG** must be either a single character placed in column 77 of the formatted record or a string of characters assigned to a special data type called FLAG on the following continuation record.

   Examples of flags on a continuation record:

   ```
   152EU2 G FLAG=ABCD$
   156GD2 L FLAG=KMP$
   ```

5. No footnotes are allowed for records of **RTYPE : N, P, or Q.**

6. To change the standard label heading of a formatted field, e.g. S to C^2S for **L** records, **CTEXT** should have the form LABEL=name, where "name" is the new label desired. The new label should be kept as short as possible. Note that **FLAG** cannot be specified with relabeling; also any other comment on the relabelled field must appear on a different record.

   Examples of field relabel:

   ```
   156GD CL S$LABEL=C2S
   156GD CL S$LABEL=DSIGMA/DOMEGA (45 DEG)
   ```

5. THE PARENT RECORD

*(Required for all decay data sets, except **IT** and **SF** decays. Must precede **L, C, B, E, A, DP** records.)*

Field(Col.)	**Name**	**Description**	**Reference**
1-5	**NUCID**	Parent nucleus identification	**V.1**
6		Blank	
7		Must be blank	
8	**P**	Letter 'P' is required	
9		Blank	
10-19	**E**	Energy of the decaying level in keV (0 for ground state)	**V.18**
20-21	**DE**	Standard uncertainty in **E**	**V.11**
22-39	**J**	Spin and parity	**V.20**
40-49	**T**	Half-life; units *must* be given	**V.14**
50-55	**DT**	Standard uncertainty in **T**	**V.12**
56-64		Must be blank	
65-74	**QP**	Ground-state Q-value in keV (total energy available for g.s.–g.s. transition); it will always be a positive number	**V.9**
75-76	**DQP**	Standard uncertainty in **QP**	**V.11**
77-80		Must be blank	

Note: More than one parent card is allowed in a data set. If the decay scheme is due to more than one parent level then separate **P** records should be given for each parent level.

6. THE NORMALIZATION RECORD

*(Must precede **L, C, B, E, A, DP** records*

. Required if an absolute normalization is possible ;used mainly with decay and (n,γ) reaction data sets.)

Field(Col)	**Name**	**Description**	**Reference**
1-5	**NUCID**	Nucleus (daughter/product) identificatio	**V.1**
6		Blank	
7		Must be blank	
8	**N**	Letter ‘N’ is required	
9		Blank	
10-19	**NR**	Multiplier for converting relative *photon* intensity **RI** (in the **GAMMA** record) to *photon*s per 100 decays of the parent through the decay branch or to photons per 100 neutron captures in an (n,γ) reaction. *Required* if the absolute photon intensity can be calculated.	**V.9**
20-21	**DNR**	Standard uncertainty in **NR**	**V.11**
22-29	**NT**	Multiplier for converting relative transition intensity (including conversion electrons) **[TI** in the **GAMMA** record] to transitions per 100 decays of the parent through this decay branch or per 100 neutron captures in an (n,γ) reaction. *Required* if **TI** are given in the **GAMMA** record and the normalization is known.	**V.9**
30-31	**DNT**	standard uncertainty in **NT**	**V.11**
32-39	**BR**	Branching ratio multiplier for converting intensity per 100 decays through this decay branch to intensity per 100 decays of the parent nucleus. *Required if known.*	**V.9**
40-41	**DBR**	Standard uncertainty in **BR**	**V.11**
42-49	**NB**†	Multiplier for converting relative ß⁻ and ε intensities (**IB** in the B- record; **IB, IE, TI** in the **EC** record) to intensities per 100 decays through this decay branch. *Required if known.*	**V.9**
50-55	**DNB**	Standard uncertainty in**NB**	**V.11**
56-62	**NP**	Multiplier for converting per hundred delayed-transition intensities to per hundred decays of precursor	**V.9**
63-64	**DNP**	standard uncertainty in **NP**	**V.11**
65-80		Must be blank	

†Note: Normally β^- and ε intensities are glven as per 100 parent decays and therefore NB=1.0. If a value other than 1.0 is given it should be remembered that the multiplier for conversion to per 100 decays is NB×BR. Also, the uncertainties in $I(\beta^-)$ will be calculated from addition of three quantities $\Delta(I(\beta^-))$, DBR and DNB in quadrature. Unless the uncertainties are precisely known it is recommended that NB be given without uncertainty.

6A. The Production Normalization RECORD

(Must follow N record, if N record present. It should be given when G records present>)

Field (Col.)	Name	Description	Reference
1-5	**NUCID**	Nucleus (Daughter/Product) identification	**V.1**
6		Blank	
7	**P**	Letter "P" (for production) is required	
8	**N**	Letter"N"is required	
9		Must be blank	
10-19	**NR×BR**	Multiplier for converting relative photon intensity (**RI** in the **GAMMA** record) to *photons* per 100 decays of the parent. (Normally NR×BR). If left blank (NR-DNR) × (BR DBR) from N record will be used for normalization.	**V.9**
20-21	**UNC**†	Standard uncertainty in **NR× BR**	**V.11**
22-29	**NT*BR**	Multiplier for converting relative *transition* intensity (including † conversion electrons) [**TI** in the **GAMMA** record] to *transitions* per 100 decays of the parent. (Normally NT× BR) If left blank (NT DNT) × (BR DBR) from N record will be used for normalization.	**V.9**
30-31	**UNC**†	Standard uncertainty in **NT× BR**	**V.11**
42-49	**NB × BR**	Multiplier for converting relative β^- and ε intensities (**IB** in the B– record; **IB, IE, TI** in the **EC** record) to intensities per 100 decays. If left blank (**NT DNT) ×(BR DBR)** from N record will be used for normalization.	**V.9**
50-55	**UNC†**	Standard uncertainty in **(NB DNT)× (BR DBR)**	**V.11**
56-62	**NP**	Same as in "N" record	
63-64	**UNC†**	Standard uncertainty in **NP**	**V.11**
77	**COM**	Blank or "C" (for comment) If blank, comment associated with the intensity option will appear in the drawing in the *Nuclear Data Sheets*. If letter "C" is given, the desired comment to appear in the drawing should be given on the continuation ("nPN") record(s), col. 10-80.	
78	**OPT**	Intensity Option. Option as to what intensity to display in the drawings in the *Nuclear Data Sheets*. The available options are given below (default option 3).	

Option number	Intensity displayed	Comment in drawing
1	TI or RI(1+α)	Relative I(γ+ce)
2	TI × NT or RI× NR× (1+α)	I(γ+ce) per 100 (mode) decays
3	TI× NT × BR or RI × BR× NR (1+α)	I(γ+ce) per 100 parent decays
4	RI × NR× BR	I(γ) per 100 parent decays
5	RI	Relative (γ)
6	RI	Relative photon branchingfrom each level
7	RI	% photon branching from each level

† If left blank no ubcertainty will appear in the publication.

7. THE LEVEL RECORD

(Optional, although a data set usually has at least one.)

Field(Col.)	Name	Description	Reference
1-5	**NUCID**	Nucleus identification	**V.1**
6		Blank Any alphanumeric character other than '1' for continuation records	
7		Must be blank	
8	**L**	Letter 'L' is required	
9		Must be blank	
10-19	**E**	Level energy in keV — *Must not be blank*	**V.18**
20-21	**DE**	Standard uncertainty in **E**	**V.11**
22-39	**J**	Spin and parity	**V.20**
40-49	**T**	Half-life of the level; units *must* be given. Mean–ife expressed as the width of a level, in units of energy, may also be used.	**V.14**
50-55	**DT**	Standard uncertainty in **T**	**V.12**
56-64	**L**	Angular momentum transfer in the reaction determining the data set. (Whether it is **L_n, L_p, ΔL**, etc., is determined from the **DSID** field of the I**DENTIFICATION** record.)	**V.22**
65-74	**S**	Spectroscopic strength for this level as determined from the reaction in the **IDENTIFICATION** record. (Spectroscopic factor for particle-exchange reactions; β for inelastic scattering.) Note: If a quantity other than spectroscopic factor is given in this field, a footnote relabelling the field is required.	**V.21**
75-76	**DS**	Statandard uncertainty in S	**V.11**
77	**C**	Comment **FLAG** used to refer to a particular comment record	**V.8**
78-79	**MS**	Metastable state is denoted by 'M' or "M1" for the first (lowest energy) isomer; "M2", for the second isomer, etc.	**V.17**
80	**Q**	The character '?' denotes an uncertain or questionable level Letter 'S' denotes neutron or proton separation energy or a level expected but not observed.	

8. THE BETA (β^-) RECORD

*(Must follow the **LEVEL** record for the level which is fed by the β^-.)*

Field(Col.)	Name	Description	Reference
1-5	**NUCID**	Nucleus identification	**V.1**
6		Blank Any alphanumeric character other than '1' for continuation records	
7		Must be blank	
8	**B**	Letter"B" is required	
9		Must be blank	
10-19	**E**	Endpoint energy of the β^- in keV *Given only if measured*	**V.18**
20-21	**DE**	Standard uncertainty in **E**	**V.11**
22-29	**IB**	Intensity of the β^--decay branch†	**V.13**
30-31	**DIB**	Standard uncertainty in I**B**	**V.11**
42-49	**LOGFT**	The log *ft* for the β^- transition for uniqueness given in col. 78-79	**V.9**
50-55	**DFT**	Standard uncertainty in **LOGFT**	**V.12**
56-76		Must be blank	
77	**C**	Comment **FLAG** ('C' denotes coincidence with a following radiation . A "?" denotes probable coincidence with a following radiation.)	**V.8**
78-79	**UN**	Uniqueness classification for the β^- decay, e.g., "1U", "2U" (A blank signifies an allowed or a nonunique forbidden transition)	**V.16**
80	**Q**	The character '?' denotes an uncertain or questionable ß⁻ decay Letter "S" denotes an expected or predicted transition	

† The intensity units are defined by the **Normalization** record.

9. THE EC (or EC + β^+) RECORD

*(Must follow the **LEVEL** record for the level being populated in the decay.)*

Field(Col.)	Name	Description	Reference
1-5	**NUCID**	Nucleus identification	**V.1**
6		Blank Any alphanumeric character other than '1' for continuation records	
7		Blank	
8	**E**	Letter ‘E’ is required.	
9		Must be blank	
10-19	**E**	Energy for *electron capture* to the level *Given only if measured*	**V.18**
20-21	**DE**	Standard uncertainty in **E**	**V.11**
22-29	**IB**	Intensity of β^+-decay branch†	**V.13**
30-31	**DIB**	Standard uncertainty in **I**	**V.11**
32-39	**IE**	Intensity of electron capture branch†	**V.13**
40-41	**DIE**	Standard uncertainty in **IE**	**V.11**
42-49	**LOGFT**	The log *ft* for ($\varepsilon + \beta^+$) transition for uniqueness given in columns 78-79	**V.9**
50-55	**DFT**	Standard uncertainty in **LOGFT**	**V.12**
65-74	**TI**	Total ($\varepsilon + \beta^+$) decay intensity†	**V.13**
75-76	**DTI**	Standard uncertainty in **TI**	**V.11**
77	**C**	Commen**t FLAG** (Letter ‘C’ denotes coincidence with a following radiation. A ‘?’denotes probable coincidence with a following radiation.)	**V.8**
78-79	**UN**	Uniqueness classification for ε, β^+ decay, e.g., "lU", "2U". (A blank signifies an allowed or a nonunique forbidden transition)	**V.16**
80	**Q**	The character "?" denotes an uncertain or questionable ε, β^+ branch. \\ Letter “S” denotes an expected or predicted transition	

10. THE ALPHA RECORD

*(Must follow the **LEVEL** record f or the level being populated in the decay.)*

Field(Col.)	Name	Description	Reference
1-5	**NUCID**	Nucleus identification	**V.1**
6-		Blank	
7		Must be blank	
8	**A**	Letter ‘A’ is required	
9		Must be blank	
10-19	**E**	Alpha energy in keV	**V.18**
20-21	**DE**	Standard uncertainty in **E**	**V.11**
22-29	**IA**	Intensity of α-decay branch in *percent* of the total α decay	**V.13**
30 31	**DIA**	Standard uncertainty in I**A**	**V.11**
32-39	**HF**	Hindrance factor for α decay	**V.9**
40-41	**DHF**	Standard uncertainty in **HF**	**V.12**
42-76		Must be blank	
77	**C**	Comment **FLAG (** Letter ‘C’ denotes coincidence with a following radiation;. A “?” denotes probable coincidence with a following radiation.)	**V.8**
78-79		Must be blank	
80	**Q**	The character ‘?’ denotes uncertain or questionable α branch Letter ‘S’ denotes an expected or predicted α branch	

11. THE (DELAYED–) PARTICLE RECORD

*(Must follow the **LEVEL** record for the level which is fed by the particle.**
Records for particles which are unassigned in a level scheme should precede the first level of the data set.)

Field(Col.)	Name	Description	Reference
1-5	**NUCID**	Nucleus identification	**V.1**
6		Blank Any alphanumeric character other than ‘1’ for continuation records	
7		Must be blank	
8	**D**	Blank for prompt –, Letter ‘D’ for delayed-particle emission	
9	**Particle**	The symbol for the (delayed) particle (N=neutron, P=proton, A=alpha particle) is required	
10-19	**E**	Energy of the particle in keV	**V.18**
20-21	**DE**	Standard uncertainty in **E**	**V.11**
22-29	**IP**	Intensity of (delayed) particles in *percent* of the total (delayed-) particle emissions †	**V.13**
30-31	**DIP**	Standard uncertainty in **IP**	**V.11**
32-39	**El**	Energy of the level in the “intermediate” (mass=A+1 for n, p) nucleus in case of delayed particle	**V.13**
40-49	**T**	Width of the transition in keV	**V.14**
50-55	**DT**	Uncertainty in **T**	**V.10**
56-64	**L**	Angular-momentum transfer of the emitted particle	**V.22**
65-76		Blank	
77	**C**	Comment **FLAG** used to refer to a particular comment record	**V.8**
78	**COIN**	Letter “C”denotes placement confirmed by coincidence. Symbol “?” denotes probable	**V.15**
79		Blank	
80	**Q**	The character ‘?’ denotes an uncertain placement of the transition in the level scheme Letter “S” denotes an expected, but as yet unobserved, transition.	

* The delayed-particle record will appear in a delayed-particle data set (e.g. B-N DECAY, etc.) which should be given under the A-chain for the final nucleus. For example, “95RB B-N DECAY” should be given as data set for ^{94}Sr.

† The intensity units are defined by the **Normalization** record.

12. THE GAMMA RECORD

*(Must follow the **LEVEL** record for the level from which the γ-ray decays. Records for γ-rays which are unassigned in a level scheme should precede the first level of the data set.)*

Field(Col.)	**Name**	**Description**	**Reference**
1-5	**NUCID**	Nucleus identification	**V.1**
6		Blank Any alphanumeric character other than '1' for continuation records	
7		Must be blank	
8	**G**	Letter 'G' is required	
9		Blank	
10-19	**E**	Energy of the γ – ray in keV *– must not be blank*	**V.18**
20-21	**DE**	Standard uncertainty in **E**	**V.11**
22-29	**Rl**	Relative *photon* intensity†	**V.13**
30-31	**DRI**	Standard uncertainty in **RI**	**V.11**
32-41	**M**	Multipolarity of transition	**V.l9**
42-49	**MR**	Mixing ratio, δ (Sign must be shown explicitly if known. If no sign is given, i it will be assumed to be unknown.)	**V.10**
50-55	**DMR**	Standard uncertainty in **MR**	**V.12**
56-62	**CC**	Total conversion coefficient	**V.9**
63-64	**DCC**	Standard uncertainty in **CC**	**V.11**
65-74	**TI**	Relative total transition intensity†	**V.13**
75-76	**DTI**	Standard uncertainty in **TI**	**V.11**
77	**C**	Comment **FLAG** used to refer to a particular comment record. The symbol "*" denotes a multiply- placed γ-ray. The symbol "&" denotes a multiply-placed transition with intensity not divided. The symbol "@"denotes a multiply-placed transition with intensity suitably divided.	**V.8**
78	**COIN**	Letter "C"denotes placement confirmed by coincidence. Symbol "?"denotes questionable coincidence.	**V.15**
79		Blank	
80	**Q**	The character '?' denotes an uncertain placement of the transition in the level scheme Letter"S" † denotes an expected , but as yet unobserved, transition	

† The intensity units are defined by the **NORMALIZATION** record.

13. THE REFERENCE RECORD

(Record can occur only in Reference data set. N N DC provides the Reference data.set)

Field(Col.**)**	**Name**	**Description**	**Reference**
1-3	**MASS**	Mass number	
4-7		Must be blank	
8	**R**	Letter "R" is required	
9		Must be blank	
10-15	**KEYNUM**	Reference key number	**V.3**
16-80	**REFERENCE**	Abbreviated reference (from NSR file)	

14. THE END RECORD

(Required for all data sets. Must be the last record in a data set.)

Field(Col.)**)**	**Description**
1-80	All columns are blank

C. Summary

The following figure (Figure 3) summarizes the standard one-card formats for all allowed record types.

SUMMARY
ENSDF STANDARD ONE-CARD FORMATS

RECORD TYPE	12345	6	7	8	9	10–19	20–21	22–29	30–31	32–39	40–41	42–49	50–55	56–62	63–64	65–74	75–76	77	78–79	80
IDENTIFICATION	NUCID					DSID					DSREF					PUB	DATE			
GENERAL COMMENT	NUCID	§	+			CTEXT														
FLAGGED COMMENT	NUCID	§	+	*		SYM(FLAG)	CTEXT													
NORMALIZATION	NUCID			N		NR	DNR	NT	DNT	BR	DBR	NB	DNB							
PARENT	NUCID			P		E	DE	J			T		DT			QP	DQP			
Q-VALUE	NUCID			Q		Q^-	DQ	SN	DSN	SP	DSP	QA	DQA	QREF						
LEVEL	NUCID	§		L		E	DE	J			T		DT	L		S	DS	C	MS	Q
GAMMA	NUCID	§		G		E	DE	RI	DRI	M		MR	DMR	CC	DCC	TI	DTI	C	†	Q
BETA	NUCID	§		B		E	DE	IB	DIB			LOG FT	DFT					C	UN	Q
EC	NUCID	§		E		E	DE	IB	DIB	IE	DIE	LOG FT	DFT			TI	DTI	C	UN	Q
ALPHA	NUCID	§		A		E	DE	IA	DIA	HF	DHF							C		Q
REFERENCE	AAA			R		KEYNUM / REFERENCE														
PARTICLE	NUCID			D	‡	E	DE	IP	DIP	ED	T		DT	L				C	†	Q
XREF	NUCID			X	@	DSID														

* = RTYPE
§ = COLUMN 6 IS BLANK OR I FOR THE FIRST CARD RECORD, ANY OTHER CHARACTER FOR CONTINUATION
† = C OR ? FOR COINCIDENCE
‡ = PARTICAL SYMBOL
\+ = “C” OR “D” OR “T”
AAA = MASS NUMBER
@ = ANY CHARACTER

fig. 3

IV. RECORDS CONTAINING MORE THAN ONE CARD

A. Card Enumeration

If all the information for a given record type cannot be contained on a single card, it is possible to use additional cards to describe the record fully. The first card of a record will have a blank in column 6. Subsequent cards will have characters different from blank or 1 (usually running numbers: 2 to 9 or letters A to Z).

B. Format for Continuation Cards

THE CONTINUATION RECORD

*(Must follow the record of the same **RTYPE.**)*

Field(Col.)	Name	Description
1-5	**NUCID**	Nucleus identification
6		Any alphanumeric character other than 1. Note: "S'" is reserved for computer-produced records which will usually be suppressed in the *Nuclear Data Sheets.*
7		Must be blank
8	**RTYPE**	Letter corresponding to the rqcord type **L, B, E**, or **G**
9		Must be blank
10-80	**Data**	<quant><op><value>[<op><value>][<ref>]$ …

In the description of **Data** above the following abbreviations have been used:

<quant>: Standard symbol for a quantity as defined in **IV.3** below.
Notes: 1. Ratios of more than two quantities should be indicated by colons not slashes (e.g., K:L1:L2:L3, not K/L1/L2/L3).
2. See **V.23** for description of <value> when <quant>=XREF

<op>: =, <, >, EQ, AP, LT, LE, GT, GE
Note: The last 6 operators require blanks before and after them are required.

<value>: Numeric value with units as needed and optional uncertainty. Uncertainty is as defined in Sections **V.11** and **V.12.**
Note: For ranges, uncertainties should not be included.
To specify a bounded range of values a second operator (note that =, EQ, AP are not valid) and value are required.
See examples below.

[ ]: Optional.

<ref>: 6 character key numbers, **KEYNUM** (see **V.3)**, separated by commas and enclosed within parentheses, e.g., (76TU01,81BO01).

$: Delimiter (end of record is also a delimiter; thus '$' should not be the last character in a record)

Examples:

```
126TE2 G BE2W=25.3 7(70LAZM)
126I 2 L %EC+%B+=56.3 20 (77JA04)$%B- EQ 43.7 20 (77JA04)
l26SN 2 B EAV=2030 60
126TE 2 L G LE 0.19 GT 0.1 (81SH15)$MOME2 AP -0.20$BE2=0.478 12
```

C. Allowed Data Types on Continuation Records

Each record type is permitted to contain only a limited (but extendable) set of data types. For example. a **GAMMA** record is not allowed to contain information of data type **DTYPE** = **J** (nuclear spin). Neither may a **LEVEL** record contain **LOGFT** information.

No continuations are allowed for **Q**, **N,** and **P** records. For **A** and **DP** records only data type FLAG is allowed on the continuation records. For the special format for the continuation of **IDENTIFICATION** records see III.B-1. The allowed record types for **LEVEL**, **GAMMA, B-,** and **EC** records are described below.

1. The LEVEL Record

Allowed data types **E, DE, J, T, DT, L, S, DS, C, MS,** and **Q** are described with the standard formats in Section **III.B.6.** Additional allowed data types are:

TYPE	Description
%EC, %B+, %EC+%B+, %B–, %IT, %SF, %A, %P, %N	Percent decay of the level by ε, β^+, ε+β^+, β^- isomeric transition, spontaneous fission, α, proton, or neutron decay
%B-N; %B-xN; …	Percent delayed decay through n,xn emission. Similarly for other particle emissions, e.g., p, xp, α, xα, etc., following β^-, β^+, or ε decays. *Note: Decay modes must be given on "2 L" card in adopted set.*
G	g-factor of the level
MOME1, MOME2, ….	Electric moments: dipole, quadrupole, …
MOMM1, MOMM2,…	Magnetic moments: dipole, quadrupole, …
CONF	Nuclear configuration of the level
BE1, BE2, ...	Reduced electric transition probability *(upward)*, given in units $e^2 \times (\text{barns})^L$, where L = 1, 2, ... for the transition from the ground state to this level
B2, B3,	2^L-pole (L=2,3,…) nuclear deformation parameter
ISPIN	Isobaric spin
ISPINZ	Z-component of isobaric spin
WIDTH,WIDTHG,WIDTHG0, WIDTHN,WIDTHP,WIDTHA	Level width, Γ, Partial–γ, –γ0, –n, –p, –α widths, Γ(γ), Γ(γ0), Γ(n), Γ(p),Γ(α), respectively
XREF	Cross-reference to other data sets for that nuclide
FLAG	Additional footnote symbols

2. The GAMMA Record

Allowed data types, **E, DE, RI, DRI, M, MR, DMR, CC, DCC, TI, DTI, C, COIN, Q** are described with the standard formats in Section **III.B.7.**

Additional allowed data types are:

DTYPE	Description
BE1, BE2, ...	Reduced electric transition probability *(downward)* given in units of $e^2 \times (\text{barns})^L$, where L = 1, 2, ...
BE1W, BE2W,…	Reduced electric transition probability *(downward)* given in single-particle (Weisskopf) units
BM1, BM2, ...	Reduced magnetic transition probability *(downward)* given in units of $\mu^2_N \times (\text{barns})^{L-1}$, where L = 1, 2, ...
BM1W, BM2W, ...	Reduced magnetic transition probability *(downward)* given in single-particle (Weisskopf) units
CEK, CEL, CELl, ...	Conversion-electron (ce) intensity for K, L, L_1, ... conversion
ECC	Measured total conversion coefficient
KC, LC, LlC,	Theoretical K– L–, L_1–, ... conversion coefficient
EKC, ELC, EL1C, ...	Measured K–, L–, L_1–, ... conversion coefficient
K/L, M/L, L1/L2, ...	Conversion-electron intensity ratios
K/T, L/T…	Ratio of K, L, ... ce– intensity to total (γ + ce) intensity
CE	Total conversion electron intensity
FL	Final level energy
FLAG	Additional footnote symbols

3. The BETA (β^-) Record

Allowed data types **E, DE, IB, DIB, LOGFT, DFT, C, UN, Q** are described with the standard formats in Section **III.B.9** Additional allowed data types are:

DTYPE	Description
EAV	Average energy of the β^-spectrum
FLAG	Additional footnote symbols (Note: ‘C’ and ‘?’ may not be used – see III.B.8 for their special meaning)

4. The EC Record

Allowed data types, **E, DE, IB, DIB, IE, DIE, LOGFT, DFT, Tl, DTI, C, UN, Q** are described with the standard formats in Section **III.B.9**. Additional allowed data types are:

DTYPE	Description
EAV	Average energy of the β^+ spectrum
CK, CL, CM,...,**CL**+	Calculated fraction of decay by electron capture from the **K, L, M, ..**., **L+M+**... shells (**K,** ...**L**,**M**,…, **L**+ are also acceptable as **DTYPE** and have the same meaning.)
ECK, ECL, ECM, ..., **ECL+**	Measured fraction of decay by electron capture from the **K, L, M,** .., **L+M+**... shells
CK/T, CL/T, ...	Ratio of **K, L, ...**ε– intensity to total ε intensity
FLAG	Additional footnote symbols (Note: “C” and “?” may not be used –- see III.B.9 for their special meaning)

V. DETAILED FIELD DESCRIPTIONS

1. NUCID

The standard nucleus identification consists of two parts—mass number in columns (1-3), right justified, and element name (or Z-100 for Z>103) in columns 4-5, left justified. The nucleus identification must be contained *within* the field defined for it (columns 1-5). The nucleus identification *must* be included on every **IDENTIFICATION** record. It must also be included on every card of a data set except the **END** record. Comments and reference data sets pertaining to the whole A-(mass) chain evaluation contain only the A-value in the **NUCID** field.

2. DSID

The Data Set I**D** for an ENSDF data set must serve as a unique, computer-recognizable identification for the data set. For that purpose, the following rules should be strictly observed for ENSDF entries. Single blanks have meaning and should be used according to the formats below. A colon may be used to define a sub-topic. All characters must be confined to the 30 spaces allowed. *Optional fields are given in italics.* General categories are given in upper and lower cases and further defined.

GENERAL ID'S

REFERENCES
COMMENTS (see Appendix B for format for this data set)
ADOPTED LEVELS
ADOPTED LEVELS, GAMMAS

DECAY DATA SET ID'S

Parent Mode Decay *(Half - life)*

Parent should be the parent isotope symbol (e.g.) 52CR.
Mode may be one of **B+, B-, EC, IT, A, P, B-N, ECP,** or **SF.**
Half-life can be of the form **T** defined in **V.14.1.**

MUONIC ATOM

REACTION DATA SET ID'S

Target(Reaction), *(Reaction)*, *Target(Reaction)* *E=Energy Qualifier*
COULOMB EXCITATION *(Reaction)*
INELASTIC SCATTERING
(HI,XNG)

Target should be the target (isotope or element) symbol.
Reaction should be a reaction symbol (e.g.) **N,P**.
Energy may be one of the following:

NUM, NUM Units (for definition of NUM see **V.9.)**
NUM-NUM Units
THERMAL or TH
RESONANCE or RES

Qualifier may be one of the following RES, IAR or IAS.

EXAMPLES:

187RE B- DECAY
187AU P DECAY:?
95RB B-N DECAY
186W(N,G) E=TH: SECONDARY G'S
186W(N,G) E=RES: AVG
187OS(D,D') E=12, 17 MEV
187RE(D,2NG), 187RE(P,NG)

187OS IT DECAY (231 US)
190PT A DECAY (6E11 Y)
186OS(N,G) E=THERMAL
RE(N,N'):TOF
189OS(P,T) E=19 MEV
185RE(A,2NG) E=23-42.8 MEV
44CA(P,G) E=856, 906 KEV IAR

3. DSREF, KEYNUM, QREF

The **DSREF** and **QREF** fields may include up to three key numbers (**KEYNUM)**, each of which refers to a particular publication. Additional key numbers may be placed in **COMMENT** records. *Key numbers must be left-–justified and separated by commas with no blanks between the comma and the reference.* A reference key number must be of the form **YYAABB** where **YY** is a two-digit integer, **AA** are two alphabetic characters and BB is either a two-digit integer or consists of two alphabetic characters. Examples: **81TU01, 81TUXY,** etc.

4. PUB

Publication information consists of the year of the A-chain publication in *Nuclear Data Sheets* denoted by a two-digit year indicator followed by the three-character code **NDS**. This may optionally be followed by a comma and other updating information, e.g., the initials of the person modifying the data set after its publication. Example: **78NDS.TWB** or **81NDS.**

5. DATE

This field is of the form **YYMMDD** where **YY**, **MM** and **DD** are two digit integers within the following ranges: **00 ≤ YY ≤ 99, 01 ≤ MM ≤ 12, and 01 ≤ DD ≤ 31**.

6. RTYPE

RTYPE is a one-letter code in column 8 that gives a name to the **RECORD** type.

RTYPE	Description
blank	May be **IDENTIFICATION,** general **COMMENT,** or **END** record
N	**NORMALIZATION** record
P	**PARENT** record
Q	**Q-VALUE** record
L	**LEVEL** record
G	**GAMMA** record
B	**BETA (B^-)** record
E	**EC (or EC + B^+)** record
A	**ALPHA** record
R	**REFERENCE** record
X	**CROSS-REFERENCE** record
DP	**DELAYED PARTICLE** record, or PARTICLE (column 8=blank) record. Particle symbol (e.g.,”P” for proton) is given in column 9.

7. CTEXT

This field consists of free text. The various expressions used in **CTEXT** can be translated via dictionary lookup. The translation dictionary is given in Appendix D. The unit expression used in translation is the string of characters between adjacent “delimiters”. The characters presently used as “delimiters” are:

b(blank) ,(comma) .b(period followed by a blank); : ( ) - = + < > / and $

In some cases the dictionary lookup programs look beyond the next delimiter for proper translation.

8. SYM(FLAG)

The **SYM(FLAG)** field (with **FLAG** given) is valid only for records with **RTYPE L, G, B, E, A, and DP**. However, **SYM** (without **FLAG)** may additionally be used for record types **N, P**, and **Q.**

FLAG can be a string of characters *optionally* separated by commas. Any character other than a comma and parenthesis can be used as a **FLAG** symbol. For **B** and **E** records,”C”cannot be used for a **FLAG,** as “C”in column 77 of **B**, **E**, and **A** records denotes coincidence. Similarly”*” and “&” for **G** records are reserved to denote multiple placement in the level/decay scheme. See notes on **SYM** and **FLAG** on page 9. Note also that **FLAG** can be used only with BAND and CONF in addition to those **SYM**s which are valid data types on a formated card. *In fact, for BAND **FLAG** must be given.*

Allowed symbols to be used as **SYM** for various **RTYPE** are given below:

RTYPE	Allowed **SYM**
L	E, DE, J, T, DT, L, S, DS, BAND, CONF, BE1, BE2, ..., B2, B3, ..., G, ISPIN, ISPINZ, MOME1, MOME2, ..., MOMM1, MOMM2, ..., %EC+%B+, %X (X=B–, B+, EC, IT, SF, A, P, or N), %XY (X=B–, B+, or EC; Y=N, P, A, ..., or KN, KP, KA, ... where K=2,3, ..., or 9), WIDTH, WIDTHG, WIDTHG0, WIDTHN, TITLE
G	E, DE, RI, DRI, M, MR, DMR, CC, DCC, TI, DTI, BE1, BE2, BE1W, BE2W, ..., BM1, BM2, ..., BM1W, BM2W, ..., CC, CEK, CEL, CEL1, ..., KC, LC, L1C, ..., CE, EKC, ELC, EL1C, ..., K/L, M/L, L1/L2, ..., K/T, L/T, ..., TITLE
B	E, DE, IB, DIB, LOGFT, DFT, EAV, TITLE
E	E, DE, IB, DIB, IE, DIE, LOGFT, DFT, TI, DTI, EAV, CK, CL, CM, CN+, ECK, ECL, ECM, ECN+, CK/T, CL/T, TITLE
A	E, DE, IA, DIA, HF, DHF, TITLE
N	NR, DNR, NT, DNT, BR, DBR, NB, DNB
P	E, DE, J, T, DT, QP, DQP
Q	Q–, DQ– SN, DSN, SP, DSP, QA, DQA
DP	E, DE, IP, DIP, EL, T, DT, L

9. CC, NR, NT, BR, NB, QP, LOGFT, HF

These fields consist of either a blank or a single unsigned number (NUM) in one of the following forms:

1. An integer (e.g., 345)
2. A real number (e.g., 345.23)
3. An integer followed by an integer exponent (e.g., 345E– 4, 4E+5)
4. A real number followed by an integer exponent (e.g., 345.E– 4)

Note: It is desirable to write a number as '0.345' rather than '.345'. However, even if the leading '0' were omitted , presumably to save space, it will appear with a leading '0' in the *Nuclear Data Sheets.*

10. Q-, SN, SP, QA, MR

These fields have the same form as the quantities in V.9. above with the difference that they are allowed to have signature (positive or negative), and R can be within parentheses.

11. DNR, DNT, DBR, DNB, DQP, DQ-, DSN, DSP, DQA, DE, DRI, DTI, DIB, DIE, DCC, DIA, DS, DHF

These one- or two-character fields represent uncertainty in the "standard" form in the given quantity. The "standard" numeric uncertainty denotes an uncertainty in the last significant figure(s), for example, NR=0.873, DNR=11 represent a normalization factor of 0.873±0.011. Similarly QP=2.3E6, DQP=10 stand for a Q-value of $(2.3\pm1.0)\times10^6$ (see also Appendix F-1). The non-numeric uncertainty, e.g, <, >, or ≥, etc. is denoted by expressions LT, GT, and GE, etc.

The allowed forms for these fields are summarized below:

1.Blank

2.An integer ≤99, preferably ≤25, (left or right justified)

3.One of the following expressions:

LT, GT, LE, GE, AP, CA, SY

for less than, greater than, less than or equal to, greater than or equal to, approximately equal to, calculated, and from systematics, respectively.

12.DFT, DMR,DT

These fields allow for the specification of "standard" asymmetric uncertainty. For example, T=4.2 S DT=+8–10, represent a half-life=$4.2^{+0.8}_{-1.0}$ s; similarly, MR= – 3 DMR= +1– 4 represent mixing ratio= -3^{+1}_{-4} meaning a range from – 7 to – 2. (Note: asymmetric uncertainties add algebraically.) When the + / – construction is missing from this field, the digits or the expressions given in this field represent either the numeric "standard" symmetric or the non-numeric uncertainty as described in **V.11.** above.

To summarize this field, there are two cases:

1 Symmetric uncertainty—the field consists of an integer number or an expression of the type described in K. above.

2. Asymmetric uncertainty—the field is of the form + x – y, where x and y are integers.

13. RI, TI, IB, IE, IA

The following numbers/expressions are valid for these fields:

1. NUM (number as defined in **V.9** above)
2. (NUM)

Note: Parentheses denote that the number given has been deduced (not directly measured) or taken from other experiment(s).

14.T

The field for half-life **T** must have one of the following forms:

1 NUM–Blank–-Units (i.e. number as defined in **V.9** above followed by a blank and its units). Valid symbols for units are: Y, D, H, M, S, MS, US, NS, PS, FS, AS, EV, KEV, and MEV for year, day, hour, minute, second,(s), 10^{-3} s, 10^{-6} s, 10^{-9} s, 10^{-12} s, 10^{-15} s, 10^{-18} s, eV, 10^{3} eV, and 10^{6} eV, respectivel.

2. Word "STABLE"

Note: A question mark following half-life denotes that the assignment to that level is not certain. A comment should be given to explain the exact meaning intended.

15. COIN

This one character field can either be blank or have character "C" or '?'. The character "C" denotes coincidence, while '?' denotes questionable coincidence.

l6. UN

This two-character field can either be blank or have an integer between 1 and 9 followed by the character "U".

17. MS

This two-character field can either be blank or have an "M" followed by a blank or a digit between 1 and 9.

18. E

An energy field **E** can have only one of the following forms:

1 NUM (as defined in **V.9.** above)
2 NUM+A or A+NUM, where A=X, Y, Z, U, V, or W used in this order; i.e., for the first occurrence an ‘X’ is used, for its second occurrence a ‘Y’ is used, and so on.
3 SN+NUM, SP+NUM, SN+A, or SP+A (where A is as defined in 2. above)
4 A (as defined in 2. above)

Note: Parentheses are allowed for this field. They denote that the number given has been deduced (not directly measured) or taken from other experiment(s). Explanation as to what is intended should be given.

19. M

The multipolarity field can be one of the following:

1. Mult

2. Mult+Mult

3. Mult,Mult

4. NOT Mult

5. IF Mult or [MULT]

where Mult = E_L or M_L, (where L, L' are single digits – L ≥0, L' ≥1) or
$M_{L'}$+E_L or
E_L+$M_{L'}$ or
D or Q

Note: Parentheses in the multipolarity field denote that the assignment is probable and not definite. Square brackets indicate assumed or derived assignment.

.20. J

The spin-parity field can have only one of the following forms:

1. JPI

2. JPI OR JPI (‘,’ (comma) can be used in place of ‘OR’)

3. JPI AND JPI (‘&’ (ampersand) can be used in place of ‘AND’)

4. OP JPI (where OP is AP, LE, or GE
 Note: This will be interpreted as π=PI and J is OP J
 Example: LE 5+ means π=+ and J≤

5. NOT JPI

6. JPI TO JPI (‘:’ (colon) can be used in place of ‘TO’)

Note: If parity is given in the range it will be interpreted as follows:

a. J to J'PI means J≤J≤J' and π=PI
b. JPI to J'PI' means JPI,J=J+1 PI=±,...,J=J'-1 PI=±,J'PI'
c. JPI to J' means JPI,J=J+1 PI=±,...,J=J'–1 PI=±,J' PI=]I:0.5

Examples:

a. 3 to 6– means Jπ=3– , 4–, ,5–, 6–,
b. 3+ to 6– means Jπ=3+,4±,5±,6–
c. 3+ to 6 means Jπ=3+,4±,5±,6±

7. NATURAL/UNNATURAL

In the above,   J = N or N/2 (N is a positive integer or zero)
PI = + or –
JPI = J or PI or J followed by PI.

Notes:

1. Parentheses in the J^{π} field indicate that the parenthesized value(s) is (are) based upon weak arguments. See "Bases for Spin and Parity Assignments" — Appendix F-4. Note that JPI = (3,4)– is interpreted as J=(3) or (4) and π=–.
2. As far as possible, do not give more than three JPI values.
3. The ranges such as 3- to 5+ are better written as 3– ,4,5+.
4. Square brackets around J^{π} value indicate an assumed value.

21. S

This field may contain no more than three S-values, in the form of NUM defined in **V.9,** separated by a '+' or a comma, for corresponding L-values given in the L-field (columns 65-74). Parentheses are allowed and will be interpreted to mean probable values.

22. L

This field may contain no more than three integer numbers optionally preceded by LE or GE and separated by a "+" or a comma. Parentheses are allowed and will be interpreted to mean probable values. Square brackets indicate assumed or derived values.

For certain reactions the excitation L value may be accompanied by its electric or magnetic character in the form similar to multipolarity (V.19).

23. Cross Reference

The cross referencing of a record (currently allowed only for the "L" record in an ADOPTED data set) is done through specification on the continuation record and it takes the following forms:

1. NUCID 2 L XREF=ABC$
   Above record indicates that the adopted level (specified by the preceding 'L' record) has been seen in data sets "A", "B", and "C", and that the corresponding levels are unambiguous.
2. NUCID 2 L XREF=A(E1)B(E2)C(E3)$
   This record indicates that the adopted level is the same as the E1 level in data set "A" the E2 level in data set "B" etc.
3. NUCID 2 L XREF=A(E1,E2)B(E3)$
   This record indicates that the adopted level is either the E1 or the E2 level in data set "A", the E3 level in data set "B."
4 NUCID 2 L XREF=A(*E1)B(E2)$
   This record indicates that a level with energy E1 in data set "A" is associated with two adopted levels. An "*" must appear on all occurrences of a multiply assigned level. Alternatively, the notation A(*) may be used if the energy is apparent.
5 NUCID 2 L XREF=+$
   This record indicates that the adopted level has been seen in all data sets.
6. NUCID 2 L XREF=– (AB)$
   This record indicates that the adopted level has been seen in all data sets except the data sets "A" and "B".

Note: The symbols A, B, C relating to specific data sets must be defined through Cross–Reference records (see **III.B.3).**

APPENDIX A

CHARACTER SET

The character set available includes all characters currently used at the NNDC and provides for future expansion. The base character set is the standard seven-bit ASCII character set up to octal 173. Characters with octal values of 173 and greater are used as control characters. An alternate character set is defined which consists primarily of the Greek alphabet and special symbols. The backslash character (octal 134) is interpreted as a backspace command. An alternate character in the input file consists of two characters, a control character and the standard character equivalent of the alternate character. All available alternate characters and their standard equivalents are given in Table IV.

There are four control characters: “| ” (octal 174), “~” (octal 170), “{“ (octal 173) and “}” (octal 175). The vertical bar and the tilde are used to shift the next character into the first and second alternate character sets respectively. Entire strings of characters may also be modified from their standard form. In this case the string to be modified is enclosed by the open and close brace control characters. The character immediately following the open brace is interpreted as a control character. The available control character values and their meanings are given in Table V. Modified character strings may be nested, but one may not terminate a string without terminating all strings nested within that string. The control character may be either upper or lower case .

EXAMPLES

|g	will be displayed	γ
{B{+238}Pu}	will be displayed	**^{238}Pu**

Special compound characters can be generated as follows:

$\bar{\nu}$	from	|n"backslash character"|"
ħ	from	|h"backslash character"|`
ƛ	from	|l"backslash character"|`

TABLE A-1

STRING CONTROL CHARACTERS

1 OR |	–	first alternate character set
2 OR ~	–	second alternate character set
+	–	superscript
–	–	subscript
I	–	italic
S	–	script
B	–	boldface
U	–	underline
O	–	overscore
E	–	elevate characters
R	–	raise base line

Note: + and – are mutually exclusive, as are I and S.

APPENDIX A (cont.)

TABLE A-2

AVAILABLE CHARACTERS

OCTAL	STANDARD	ALTERNATE	OCTAL	STANDARD	ALTERNATE
40	(blank)	(blank)*	116	N	N
41	!	©_	117	O	O
42	"		120	P	Π
43	#	§	121	Q	Θ
44	$	e	122	R	Ρ
45	%	√	123	S	Σ
46	&	≡	124	T	Τ
47	'	∘	125	U	ϒ
50	(	←	126	V	∇
51	)	→	127	W	Ω
52	*	×	130	X	Ξ
53	+	±	131	Y	Ψ
54	,	1/2	132	Z	Ζ
55	-	∓	133	[	{
56	.	∝	134		|
57	/	÷	135	]	}
60	0	(	136	ˆ	↑
61	1	)	137	_	↓
62	2	[	140	`	´
63	3	]	141	a	α
64	4	〈	142	b	β
65	5	〉	143	c	η
66	6	√	144	d	δ
67	7	∫	145	e	ε
70	8	∏	146	f	ϕ
71	9	∑	147	g	γ
72	:	†	150	h	χ
73	;	‡	151	i	ι
74	<	≤	152	j	ε
75	=	≠	153	k	κ
76	>	≥	154	l	λ
77	?	≈	155	m	μ
100	@	∞ •	156	n	ν
101	A	Α	157	o	ο
102	B	Β	160	p	π
103	C	Η	161	q	θ
104	D	Δ	162	r	ρ
105	E	Ε	163	s	σ
106	F	Φ	164	t	τ
107	G	Γ	165	u	υ
110	H	Χ	166	v	∂
111	I	Ι	167	w	ω
112	J	˜	170	x	ξ
113	K	Κ	171	y	ψ
114	L	Λ	172	z	ζ
115	M	Μ			

* The first ALTERNATE blank is an invariant character, one half the width of the STANDARD blank; ; and the second ALTERNATE blank is one quarter the width of a STANDARD blank.

APPENDIX B

FORMAT FOR COMMENTS DATA SET

This data set consists only of general comment records (defined in III.B(4)). The format of the comment records is similar to general comments in other data sets except that the NUCID field will contain only the mass number, AAA, and that a SYM field is required as in a flagged comment. As in the flagged comments, the SYM field will either occupy columns 10 to 19 with column 19 being blank or the SYM will be followed by a "$". Continuation records for a given comment are allowed with the additional feature that a new line will be started if the continuation character in column 6 is a "#" and that a new paragraph will be started if the character is a "@". This feature is intended to facilitate the entry of information into the COMM comments.

SYM	Meaning
TITL	Title of evaluation . Required if the evaluation spans several masses.
AUTH	Authors, a list of authors from the institution given in the following INST comment. A letter or number in parentheses following an author's last name will signal a permanent address which is different from that of the institution. (See PERM.)
INST	Institution, name and address of the authors' institution. The INST comment must follow the appropriate AUTH comment. The # continuation character is used so the address does not run together into one line. More than one set of AUTH and INST comments can be given if more than one institution is involved.
ABST	Abstract, should be terse and to the point. Additional details should be given under COMM comments.
CUT	Cutoff date and associated comments.
COMM	General comments on techniques used in the evaluation or on other information common to many of the isotopes.
ACKN	Acknowledgments.
PERM(a)	Permanent address of an author—the letter or number 'a' within the parentheses corresponds to the letter or number within the parentheses which follows the author's last name in the AUTH comment.
FUND	Funding—an acknowledgment of funding which will result in a footnote being added to the title.
CIT	Citation. To be added by the NDS production staff so that the publication can be correctly cited by persons using a retrieval of the A chain. The authors may leave it out.

APPENDIX C

EXAMPLES OF INPUT/OUTPUT IN ENSDF/Nuclear Data Sheets

Appendix C– 1	EXAMPLE – COMMENTS DATA SET
Appendix C– 2	EXAMPLE – ADOPTED LEVELS
Appendix C– 3	EXAMPLE – DECAY DATA SET

APPENDIX C-– 1

Example of a Comments Data Set

```
156      COMMENTS
156   C  TITL      NUCLEAR DATA SHEETS FOR A=156
156   C  AUTH      R. G. HELMER
156   C  INST$IDAHO NATIONAL ENGINEERING LABORATORY
156  #C  EG&G IDAHO, INC.
156  #C  IDAHO FALLS, IDAHO 83415  USA
156   C  ABST      THE EXPERIMENTAL RESULTS FROM THE VARIOUS REACTION AND
156  2C    DECAY STUDIES LEADING TO NUCLIDES IN THE A=156 MASS CHAIN, AND
156  3C    ALPHA DECAYS FROM IT, HAVE BEEN REVIEWED.  THESE DATA ARE
156  4C    SUMMARIZED AND PRESENTED, TOGETHER WITH ADOPTED LEVEL SCHEMES
156  5C    AND PROPERTIES.
156   C  CUT       DATA AVAILABLE PRIOR TO JUNE 1985 HAVE BEEN EVALUATED.
156   C  ACKN      THE EVALUATOR WISHES TO THANK M. A. LEE AND C. W.
156  2C    REICH FOR MANY HELPFUL DISCUSSIONS AND A. L. FREEMAN FOR THE DATA
156  3C    ENTRY AND PROCESSING.
156   C  FUND      RESEARCH SPONSORED BY THE U. S. DEPARTMENT OF ENERGY.
156   c  COMM$In this evaluation, the following expression was used to define
156  2c  the rotational-band parameters A and B:
156  #c
156  #c      E(J) = E{-0} + AJ(J+1) + B[J(J+1)]{+2}.
156  #c
156  #c  For the levels in {+156}Gd the parameters A{-2} and A{-4}    representing
156  7c  the shift between the odd- and even-spin levels have also been
156  8c  calculated for some bands from the expressions
156  #c
156  #c      E(J) = E{-0} + AJ(J+1) - (-1){+J}A{-2}J(J+1)    for K|p= 1+
156  #c  and
156  #c      E(J) = E{-0} + A[J(J+1)-K{+2}] + B[J(J+1)-K{+2}]{+2} +
156  Dc  (-1){+J}A{-4}(J-1)J(J+1)(J+2)  for K|p= 2+.
156  #c
156  #c  In the determination of the values of these parameters, the energy
156  Gc  spacings of only the lowest levels, and minimum number of levels, were
156  Hc  used.
156  @c  The term "half-life" is used to refer to a ground state or an isomer
156  2c  for which there is a separate data set. The term "lifetime" is used to
156  3c  refer to the same quantity for any other level.
156  @c  In each group of data sets for a given element, the following customs
156  Bc  are usually maintained. All of the information concerning the
156  Cc  gamma-ray multipolarities are considered and summarized in the Adopted
156  Dc  data set, and these adopted values are also quoted in all the other
156  Ec  data sets. For level lifetimes, the data in the individual data sets
156  Fc  included only values from that type of experiment. The values which
156  Gc  summarize all of the measurements are only given in the Adopted data
156  Hc  set. The J|P values for the levels are also treated in the latter
156  Ic  way, except in so far as the authors of the experimental papers have
156  Jc  already considered the results of other experiments. Since a B(E2)
156  Kc  value to a 2+ excited state from 0+ g.s. is equivalent to the
156  Lc  lifetime of E2 G in the opposite direction, a T{-1/2} value can be
156  Mc  computed from B(E2) value. This has not been done. All T{-1/2} values
156  Nc  come only from  experiments measuring this quantity.
156  @c  The ENSDF file (the computer data base from which these Data Sheets
156  9c  are produced), contains some information that is not printed in these
156  9c  Data Sheets. This includes the theoretical internal-conversion
156  9c  coefficients for each shell, where the values are significant, for
156  9c  each |g for which a multipolarity is given in the Data Sheets. Also, a
156  9c  short comment is made about the experimental methods for each
156  9c  reference. This information would be available if a copy of the ENSDF
156  9c  file were obtained.
156   C  CIT       NDS 49,383 1986
```

Output example for Comments Data Set

Nuclear Data Sheets for A = 156*

R. G. HELMER
Idaho National Engineering Laboratory
EG&G Idaho, Inc.
Idaho Falls, Idaho 83415 USA

(Received October 10, 1985; Revised March 27, 1986)

Abstract: The experimental results from the varioua reaction and decay studies leading to nuclides in the A=156 mass chain and α decays from it have been reviewed. These data are summarized and presented together with adopted level schemes and properties.

Cutoff Date: Data available prior to June 1985 have been evaluated.

Organization of Material: See page *v*.

Acknowledgements: The evaluator wishes to thank M. A. Lee and C. W. Reich for many helpful discussions and A. L. Freeman tor the data entry and processing.

General Comments: In this evaluation, the following expression was used to define the rotational-band parameters A and B:

$$E(J) = Eo + AJ(J+1) + BJ(J+].$$

For the levels in ^{156}Gd the parameters A_2 and A_4 representing the shift between the odd- and even-spin levels have also been calculated for some bands from the expressions

$$E(J) = Eo + AJ(J+1) – (– 1)^J A_2 J(J+1) \text{ for } K\pi = 1^+$$

and

$$E(J) = E_0 + A[J(J+1)– K^2] + B[J(J+1)– K^2]^2 + (– 1)^J A_4(J– 1)J(J+1)(J+2) \text{ for } K\pi = 2+.$$

In the determination of the values of these parameters the energy spacing of only the lowest levels and minimum number of levels were used.

The term half-life is used to refer to a ground state or an isomer for which there is a separate data set. The term liretime is used to refer to the same quantity for any other level.

In each group of data sets for a given element the following customs are usually maintained. All of the information concerning the gamma-ray multipolarities are considered and summarized in the Adopted data set, and these adopted values are also quoted in all the other data sets. For level lifetimes the data in the individual data sets included only values from that type of experiment. The values which summarize all of the measurements are only given in the Adopted data set. The Jπ values for the levels are also treated in the latter way except in so far as the authors of the experimental papers have already conaidered the results of other experiments. Since a B(E2) value to a 2+ excited state from 0+ g.s. is equivalent to the lifetime of E2 G in the opposite direction, a $T_{1/2}$ value can be computed from B(E2) value. This has not been done. All $T_{1/2}$ values come only from experiments measuring this quantity.

The ENSDF file (the computer data base from which tbese Data Sheets are produced) contains some information that is not printed in these Data Sheets. This includes the theoretical internal-conversion coefficients for each shell where the values are significant for each γ for which a multipolarity is given in the Data Sheets. Also a short comment is made about the experimental methods for each reference. This information would be available if a copy of the ENSDF file were obtained.

* Research sponsored by the U. S. Department of Energy.

APPENDIX C-2

Example of an Adopted Levels Data Set

```
154SM    ADOPTED LEVELS                                                    870129
154SM  Q  -717.0   21 7967.9 10 9086   16 -1197.2 25   85WA02
154SM D        Other reactions: 154SM(P,P'G), 154SM(D,D'), and 152SM(t,p).
154SM T                  Summary of Adopted T Values
154SM T
154SM T E(level)   Adopted                        Comments
154SM T     0.0    Stable
154SM T    81.9    3.02 NS 4    Weighted average of 3.03 NS 5 (67WO06) and
154SM2T                           3.00 NS 6 (68RI09). Other: 2.74 NS 24 (59BI10).
154SM T   266.7     172 PS 4    Weighted average of 173 PS 5 (72DI06) and
154SM2T                           169 PS 10 (80JO08).
154SM T   543.9    22.7 PS 6    Weighted average of 23.3 PS 7 (72DI06) and
154SM2T                           22.7 PS 6 (average of two values in 80JO08).
154SM T   902.8    5.93 PS 25   Weighted average of 6.2 PS 6(72DI06), 6.0 PS 4
154SM2T                           (77KE06), and 5.6 PS 4 (80JO08).
154SM T   921.5      26 FS 4    Calculated from level width of 0.0176 eV 24
154SM T
154SM T             Summary of JPI Assignments
154SM T
154SM t  E(level) Adopted   b- decay    (n,n'g)   Coulomb excit
154SM T  -------- -------   --------    --------  -------------
154SM T      0.0    0+          0+          0+         0+
154SM T     81.9    2+          2+          2+         2+
154SM T    266.7    4+          4+          4+         4+
154SM T    543.9    6+          6+                     6+
154SM T
154SM C  The data on the level energies and JPI values are
154SM2C  primarily from the 154PM  B- DECAY.
154SM CL E         From least-squares fit to G energies.
154SM CL BAND(A)   KPI=0+ ground-state band.   A= 13.81,  B= -0.0234
154SM CL BAND(B)   Octupole-vibrational band.  A= 10.58,  B= -0.0413
154SM  XR154PM B- DECAY (1.73 MIN)
154SM  XS154PM B- DECAY (2.68 MIN)
154SM  XT154PM(3HE,3H)
154SM  XU154SM(N,N'G)
154SM  XVCOULOMB EXCITATION
154SM  XWINELASTIC SCATTERING
154SM  XX154SM(G,G')
154SM  XY152SM(T,P)
154SM  XZ154EU EC DECAY
154SM  L 0.0          0+              STABLE                                A
154SM  L   81.99   2  2+              3.02 NS   4                           A
154SM2 L   MOME2= -1.87 4 $ BE2= 4.32 2 $ MOMM1= +0.70 5 $
154SM CL J         From E2 Coulomb excitation from 0+ ground state.
154SM  L 266.74    7  4+              172 PS    4                           A
154SM2 L  MOMM1= +1.35 15 $ MOME2= -2.2 8 $ BE4= 0.305 18 $ XREF= -(TX) $
154SM CL J         From multiple Coulomb excitation and expected 0+ band
154SM2CL      structure.
154SM  L  543.9    5  6+              22.7 PS   6                           A
154SM2 L MOMM1= +1.90 28 $ XREF= SVWY
154SM CL J         From multiple Coulomb excitation and expected 0+ band
154SM2CL      structure.
154SM CL MOMM1     From 72KU10 and given as g-factor of 0.317 46.  (Also given
154SM2CL       by 76FU06 and 78LEZA.)
154SM  L  902.8    8  8+              5.93 PS   25                          A
154SM2 L  XREF= V
154SM CL J         From multiple Coulomb excitation and expected 0+ band
154SM2CL      structure.
154SM  L 921.57    11 1-              26 FS     4                           B
154SM2 L  XREF= RSUWX
154SM CL J         From E1 excitation by (G,G') reaction.
154SM2CL      partial-width data (76ME17) from (G,G') experiment.
154SM  L 1012.62   12 3-                                                    B
154SM2 L  BE3= 0.10 2 $ XREF= SUVW
154SM CL J         From E3 Coulomb excitation.
154SM CL BE3       Weighted average of 0.11 3 (68KE04) and 0.09 2 (68VE01).
154SM2CL       Other: 66SE06.
```

Example Output for the Adopted Levels Data Set

^{154}Sm Adopted Levels

$Q(\beta^-)$ = – 717.0 *21*; S(n)=7967.9 *10*; S(p)=9086 *16*; Q(α) = – 1197.2 *25* 85Wa02.

Summary of Adopted $T_{1/2}$ Values

E(level)	Adopted	Comments
0 0	Stable	
81.9	3.02 ns *4*	Weighted average of 3.03 ns *5* (67Wo06) and 3.00 ns *6* (68Ri09). Other: 2.74 ns *24* (59Bi10).
266.7	172 ps *4*	Weighted average of 173 ps *5* (72Di06) and 169 ps *10* (80JoO8).
543.9	22.7 ps *6*	Weighted average ot 23.3 ps *7* (72Di06) and 22.7 ps *6* (average of two values in 80Jo08).
902.8	5.93 ps *25*	Weighted average of 6.2 ps 6 (72Di06), 6.0 ps *4* (77Ke06), and 5.8 ps *4* (80Jo08).
921.5	26 fs *4*	Calculated from level width of 0.0176 eV *24*.

Summary of J π Assignments

E(level)	Adopted	β^- decay	(n,n'γ)	Coulomb excit
0.0	0 +	0 +	0 +	0 +
81.9	2 +	2 +	2 +	2 +
266.7	4 +	4 +	4 +	4 +
543.9	6 +	6 +		6 +

The data on the level energies and Jπ values are primarily from the ^{154}Pm β^- decay.

Cross Reference (XREF) Flags

A ^{154}Pm β^- Decay (1.73 min)
B ^{154}Pm β^- Decay (2.68 min)
C ^{154}Pm(^{3}He,^{3}H)
D ^{154}Sm(n,n'γ)
E Coulomb Excitation
F Inelastic Scattering
G ^{154}Sm(γ,γ′)
H ^{152}Sm(t,p)
I ^{154}Eu ε Decay

E(level)†	Jπ	XREF	$T_{1/2}$	Comments
0.0‡	0 +		stable	
81.99‡ *2*	2 +		3.02 ns *4*	Q = – 187 *4*; B(E2) = 4.32 *2*; μ = + 0.70 *5* Jπ: From E2 Coulomb excitation from 0+ ground state.
266.74‡ *7*	4 +	C G	172 ps *4*	μ = +1.35 *15*; Q = – 2.2 *8*; B(E4)=0.305 *18.* Jπ: from multiple Coulomb excitation and expected 0+ band structure.
543.9‡ *5*	6 +	B EF H	22.7 ps *6*	μ = +1.90 *28.* Jπ: From multiple Coulomb excitation and expected 0+ band structure. μ: From 72Ku10 and given as a g–-factor of 0.317 *46* (Also given by 76Fu06 and 78LeZA).
902.8‡ *8*	8 +	E	5.93 ps *25*	Jπ: From multiple Coulomb excitation and expected 0+ band structure.
921.57§ *11*	1 –	AB D FG	26 fs *4*	Jπ: From E1 excitation by (γ,γ ') reaction; partial-width data (76Me17) from (γ,γ ') experiment.
1012.62§ *12*	3 –	B DEF		B(E3)=0.10 *2.* Jπ: From E3 Coulomb excitation. B(E3): Weighted average of 0.11 *3* (68Ke04) and 0.09 *2* (68Ve01). Other: 66Se06.

† From least-squares fit to γ energies.
‡ Kπ = 0 + ground-state band. A=13.81, B= – 0.0234.
§ Octupole-vibrational band. A=10.58, B= – 0.0413.

APPENDIX C-3

Example of a Decay Data Set

```
154SM    154PM B- DECAY (1.7 M)        74YA07,72TA13,71DA28   87NDS      870101
154PM  P             (0,1)             1.7 M      2           4.0E+3     1
154SM  N 0.l94     30         1.0
154SM CN NR        I(G+CE)=100 TO G.S. IF IT-DECAY OF PARENT=0
154SM C  OTHERS: 68DEZZ,72H008,73PR05,74BU09.
154SM CG E,RI$FROM 74YA07 UNLESS OTHERWISE STATED.
154SM CG RI(B)$DATA NOT GIVEN; DEDUCED FROM G-BRANCHING RATIOS VIA 2.7-MIN
154SM CB           MEASURED BETAS: 71DA28,74YA07. OTHERS: 73PR05,72TA13,58WI42
154SM  G 414.8     2 5.9     9
154SM  L 0.0          0+               STABLE
154SM  L 81.98     10 2+
154SM  G 81.98     10 65     10 E2                    4.93                   C
154SMS G KC=  2.021   $LC=  2.250   $MC=  0.519   $NC+= 0.1402   $
154SM  L 266.7     2 4+
154SM  G 184.76    10 25     5 E2                     0.27                   C
154SMS G KC= 0.1925   $LC= 0.0633   $MC=0.01428   $NC+=0.00389   $
154SM CG E         FROM 71DA28. OTHER: 184.6 1 (74YA07)
154SM  L 921.6     2  1-
154SM  B             12      2           6.5                                C
154SM2 B EAV=    1250 50$
154SM CB           EB=3.0 2 MEV (74YA07,71DA28) SCIN, F-K
154SM  G 839.6     2 66.3    38                                              C
154SM  G 921.6     2 44.3    27                                              C
154SM  L 1099.7    3 0+
154SM  B             5       1           6.8
154SM2 B EAV=    1170 50$
154SM  G 1017.6    2 53.1    32                                              C
154SM  L 1178.2    3  2+
154SM  B             3.5     12          6 9
154SM2 B EAV=    1140 50$
154SM  G 911.1     3 24.1    25                                              C
154SM  G 1096.2    3 29.9    22                                              C
154SM  G 1177.8    8 19.0    19                                              C
154SM  L 1440.4    4  2+
154SM  G 1173.7    100.08    5                                              B
154SM  G 1358.6    2 1.3     4                                              B
154SM  G 1440.3    2 1.1     4                                              B
154SM  L 1476.1    3 (1-)
154SM  B             11      2           6.2                                C
154SM2 B EAV=    1000 50$
154SM  G 1394.0    2 65      10                                              C
154SM  L 1890.9    3
154SM  B             3.0     5           6.5
154SM2 B EAV=     820 50$
154SM  G 1808.8    3 8.4     13
154SM  G 1891.0    4 7.0     14
154SM  L 2089.8    3
154SM  B             25      2           5.4                               C
154SM2 B EAV=     740 50$
154SM  G 891.5     2 35.6    23
154SM  G 970.0     2 26.9    20
154SM  G 1148.1    2 48.2    30                                             C
154SM  G 1988.0    3 6.7     10
154SM  G 2070.2    3 9.6     10
154SM  L 2140.9    2
154SM  B             36      3           5.2                               C
154SM2 B EAV=     700 50$
154SM  G 664.6     2 7.2     14
154SM  G 700.4     6 2.5     8
154SM  G 962.5     2 19.1    16                                             C
154SM  G 1218.0    10
```

```
154SM  G 2058.9    2 100                                                   C
154SM  G 2140.9    2 56.7    34                                            C
154SM  L 2347.7    3
154SM  B             1.8     2           6.3
154SM2 B EAV=     610 50$
154SM  G 2347.7    3 9.2     9
154SM  L 2592.3    3
154SM  B             1.8     2           6.0
154SM2 B EAV=     510 50$
154SM  G 2510.6    2 7.0     8
154SM  G 2592.0    3 2.2     5
154SM  L 2618.2    5
154SM  B             1.0     3           6.2
154SM2 B EAV=     500 50$
154SM  G 2535.9    3 3.3     8
154SM  G 2816.8    5 2.0     8
```

Example for Radiation Tables

β^- radiations from ^{154}Pm β^- Decay (1.7 min) 74Ya07,72Ta13,71Da28

Others: 68DeZZ,72Ho08,73Pr05,74Bu09.
Measured β's: 71Da28,74Ya07. Others: 73Pr05,72Ta13,58Wi42.

Eβ-	E(level)	Iβ-†	Log ft	Comments
(1380 *100*)	2618.2	1.0 3	6.2	av Eβ=500 *50*.
(1410 *100*)	2592.3	1.8 2	8.0	av Eβ=510 *50*.
(1650 *100*)	2347.7	1.8 2	6.3	av Eβ=610 *50*.
(1860 *100*)	2140.9	36. 3	5.2	av Eβ=700 *50*.
(1930 *100*)	2069.8	25. 2	5.4	av Eβ=740 *50*.
(2110 *100*)	1890.9	3.0 5	6.5	av Eβ=820 *50*.
(2520 *100*)	1476. 1	11. 2	6.2	av Eβ=1000 *50*.
(2820 *100*)	1178.2	3.5 12	6.9	av Eβ=1140 *50*.
(2900 *100*)	1099.7	5. 1	6.8	av Eβ=1170 *50*.
(3080 *100*)	921. 6	12. 2	6.5	av Eβ=1250 *50*. Eβ=3.0 *2* MeV (74Ya07,71Da28) scin, F-K.

† For β^- intensity per 100 decays, multiply by 1.00.

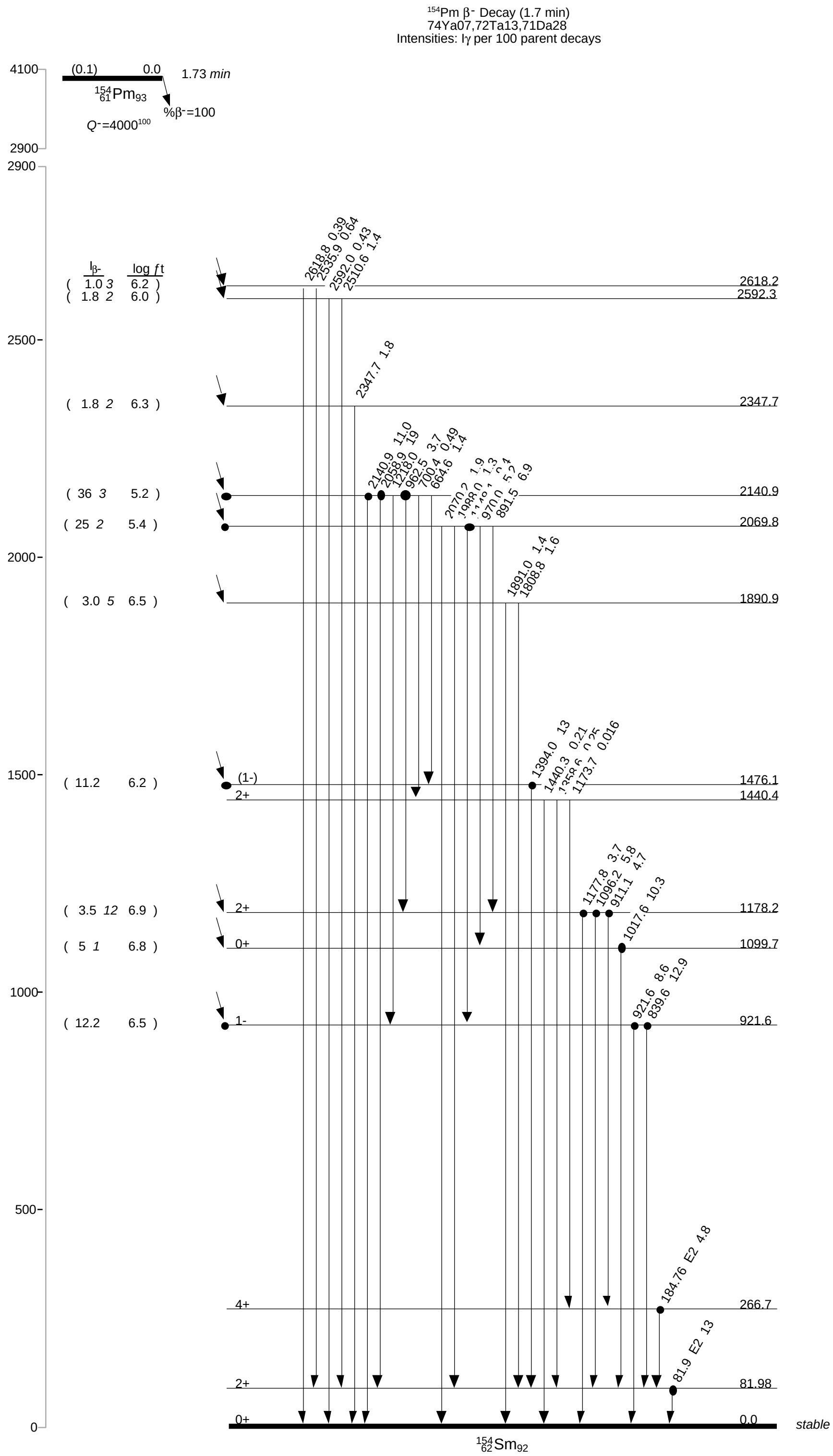
γ(^{154}Sm) from ^{154}Pm β^- Decay (1.7 min) 74Ya07,72Ta13,71Da28

I_γ normalization: I(γ+ce)=100 to g.s. if IT-decay of parent=0.

Eγ‡	E(level)	Iγ†‡	Mult.	α	Comments
81.98*10*	81.98	65 *10*	E2	4.93	α(K)=2.021; α(L)=2.250; α(M)=0.519; α(N+)=0.1402.
184.76*10*	266.7	25 *5*	E2	0.27	α(K)=0.1925; α(L)=0.0633; α(M)=0.01428; α(N+..)=0.00389. E_γ: from 71DaZ8. Other: 184.6 *1* (74Ya07).
*414.8 *2*		5.9 *9*			
664.6 *2*	2140.9	7.2 *14*			
700.4 *6*	2140.9	2.5 *8*			
839.6 *2*	921.6	66.3 *38*			
891.5 *2*	2069.8	35.6 *23*			
911.1 *3*	1178.2	24.1 *25*			
921.6 *2*	921.6	44.3 *27*			
962.5 *2*	2140.9	19.1 *16*			
970.0 *2*	2069.8	26.9 *20*			
1017.6 *2*	1099.7	53.1 *32*			
1096.2 *3*	1178.2	29.9 *22*			
1146.1 *2*	2069.8	48.2 *30*			
1173.7 *10*	1440.4	0.08§ *5*			
1177.8 *8*	1178.2	19.0 *19*			
1218.0 *10*	2140.9				
1358.8 *2*	1440.4	1.3§ *4*			
1394.0 *2*	1476. 1	65 *10*			
1440.3 *2*	1440.4	1.1§ *4*			
1808.8 *3*	1880.9	8.4 *13*			
1891.0 *4*	1880.9	7.0 *14*			
1988.0 *3*	2069.8	6.7 *10*			
2058.9 *2*	2140.9	100			
2070.2 *3*	2069.8	9.6 *10*			
2140.9 *2*	2140.9	56.7 *3*			
2347.7 *3*	2347.7	9.2 *9*			
2510.6 *2*	2592.3	7.0 *8*			
2535.9 *3*	2618.2	3.3 *8*			
2592.0 *3*	2592.3	2.2 *5*			
2618.8 *5*	2618.2	2.0 *8*			

‡ From 74Ya07 unless otherwise noted.
† For absolute intensity per 100 decays, multiply by 0.19 *3*.
§ Data not given; deduced from γ-branching ratios via 2.7-min.
* γ ray not placed in level scheme.

Example of Plot Output



APPENDIX D

ENSDF TRANSLATION DICTIONARY

The publication programs translate the text of comments (**CTEXT** in Section **III.B**) from the computer-readable **ENSDF** input into printed output for *Nuclear Data Sheetss.*.

The translation dictionary, as of January 1987, is given below. It is given sorted by the output (translation) in (Appendix D-I) and by the ENSDF input (Appendix D-II). The dictionary is constantly enlarged and improved as new needs are encountered.

APPENzDIX D-1

ENSDF DICTIONARY— ordered by output

Translation	ENSDF
A	^A
av Eβ	EAV
Ay	AY
A(θ)	A(THETA)
A-N	A-N
$A^{1/3}$	A**1/3
$A^{2/3}$	A**2/3
A_0	A0
a_0	a0
A_1	A1
A_{22}	A22
A_2	A2
A_2P_2	A2P2
A_2/A_0	A2/A0
A_3	A3
A_4	A4
B	^B
Be	Be
BE(L)	BE(L)
BF_3	BF3
BG0	BG0
BJ^2	BJ**2
BM(L)	BM(L)
Branching	BR
branching uncertainty	DBR
B(EL)	BEL
B(EL)(W.u.)	BELW
B(E0	B(E0
B(E0)	BE0
B(E0)(W.u.)	BE0W
B(E1	B(E1
B(E1)	BE1
B(E1)(W.u.)	BE1W
B(E2	B(E2
B(E2)	BE2
B(E2)(W.u.)	BE2W
B(E2)↑	BE2UP
B(E3	B(E3
B(E3)	BE3
B(E3)(W.u.)	BE3W
B(E3)↑	BE3UP
B(E4	B(E4
B(E4)	BE4
B(E4)(W.u.)	BE4W
B(E4)↑	BE4UP
B(E5)	BE5
B(E5)(W.u.)	BE5W
B(E6)	BE6
B(E6)(W.u.)	BE6W
B(E7)	BE7
B(E8)	BE8
B(J	B(J
B(ML)	BML
B(ML)(W.u.)	BMLW
B(M1)	BM1
B(M1)(W.u.)	BM1W
B(M2)	BM2
B(M2)(W.u.)	BM2W
B(M3)	BM3
B(M3)(W.u.)	BM3W
B(M4)	BM4
B(M4)(W.u.)	BM4W
B(M5)(W.u.)	BM5W
B×ρ	B*RHO
C	C
CCBA	CCBA
ce	CE
CERN	CERN
ce(K)	CEK
ce(K)/(γ+ce)	K/T
ce(L)	CEL
ce(L)/(γ+ce)	L/T
ce(L1)	CEL1
ce(L2)	CEL2
ce(L3)	CEL3
ce(M)	CEM
ce(M)/(γ+ce)	M/T
ce(M+)/(γ+ce)	M+/T
ce(M1)	CEM1
ce(M2)	CEM2
ce(M3)	CEM3
ce(M4)	CEM4
ce(M5)	CEM5
ce(N)	CEN
ce(N+)/(γ+ce)	N+/T
ce(Nl1)	CEN1
ce(N2)	CEN2
ce(N3)	CEN3
ce(N4)	CEN4
ce(N5)	CEN5
ce(0)	CE0
ce(0)+ce(P)	CE0+CEP
ceβ	CEB
ceγ	CEG
Cm	Cm
cm^2	CM2
cm^3	CM3
Co	CO
configuration	CONF
configuration=	CONF=
$cos^2θ$	COS2TH
Coul	COUL
CP	CP
CsI	CSI
c.m.	C.M.
C^2S	C2S
D	^D
DC0	DC0
DC0Q	DC0Q
dE/dx	DE/DX
DPAC	DPAC
DPAD	DPAD

ENSDF DICTIONARY— ordered by output

Translation	ENSDF
DSA	DSA
DSAM	DSAM
DWBA	DWBA
DWIA	DWIA
DWUCK	DWUCK
D+Q	D+Q
D+(Q)	D+(Q)
d^3He	D3HE
dγ	DG
dσ	DSIGMA
dσ/dΩ	DS/DW
dΩ	DOMEGA
E	E
Ee	EE
EL	EL
ENDOR	ENDOR
ENSDF	ENSDF
EPR	EPR
ESR	ESR
eV	EV
even-A	EVEN-A
EWSR	EWSR
e'(θ)	E'(THETA)
E(ce)	ECE
E(d)	E(D)
E(e)	E(E)
E(n)	EN
E(n)	E(N)
E(p)	EP
E(p)	E(P)
E(t)	E(T)
E(α)	E(A)
E-E	E-E
E/ΔE	E/DE
E0	E0
E1	E1
E2	E2
E3	E3
E4	E4
E5	E5
E6	E6
E7	E7
E8	E8
E9	E9
e^+	E+
$E^{1/2}$	E**1/2
E^2	E**2
Eα	EA
Eβ	EB
EΔE	EDE
Eε	EEC
Eγ	EG
$E\gamma^5$	EG**5
fm	FM
fm^{-1}	FM**-l
fm^{-1}	FM-1
fm^2	FM**2
fm^4	FM**4
FWHM	FWHM
F-K	F-K
GDR	GDR
Geiger	GEIGER
GeV	GEV
Ge(Li)	GELI
GM	GM
GMR	GMR
GQR	GQR
gT	G*T
GTOL	GTOL
$gT_{1/2}$	GT1/2
$gw\Gamma_{\gamma 0}$	G*W*WIDTHG0
g-factor	G-FACTOR
g.s.	GS
gΓ	G*WIDTH
$g\Gamma^2_{\gamma 0}$	G*WIDTHG0**2
$g\Gamma^2_{\gamma 0}$	*G*WIDTHG0**2
$g\Gamma_{\gamma 0}$	G*WIDTHG0
HF	HF
HI	HI
HPGE	HPGE
ħω	HOMEGA
h^2	H**2
I	I
IAR	IAR
IAS	IAS
IBA	IBA
IBS	IBS
Ice	ICE
IMPAC	IMPAC
IPAC	IPAC
ISOLDE	ISOLDE
IT decay	IT DECAY
I(γ + ce)	TI
Iα	IA
Iβ	IB
Iβ normalization	NB
$i\beta^+$	IB+
$I\beta^-$	IB–
Iε	IE
Iγ	IG
Iγ	RI
Iγ normalization	NR
IγEγ	IG*EG
J	J
JKπ	JKP
Jmax	JMAX
Jmin	JMIN
JOSEF	JOSEF
JULIE	JULIE
J_f	JF

ENSDF DICTIONARY— ordered by output

Translation	ENSDF
J_i	JI
J_0	J0
J_1	J1
J_2	J2
Jπ	JPI
K	K
keV	KEV
kG	KG
KLL	KLL
kOe	KOE
K-O_{23} x ray	XKO23
K-O_2 x ray	XKO2
K-O_3 x ray	XKO3
K/L+M	K/L+M
K x ray	XK
$K\alpha_1$ x ray	XKA1
$K\alpha_2$ x ray	XKA2
Kα x ray	XKA
$K\beta_1$ x ray	XKB1
$K\beta_1'$ x ray	XKB1P
$K\beta_2$ x ray	XKB2
$K\beta_2'$ x ray	XKB2P
$K\beta_3$ x ray	XKB3
$K\beta_4$ x ray	XKB4
$K\beta_5$ x ray	XKB5
$K\beta_5^{I}$ x ray	XKB5I
$K\beta_5^{II}$ x ray	XKB5II
Kβ x ray	XKB
Kπ	KPI
L	L
LAMPF	LAMPF
Larmor	LARMOR
Li	LI
log *f*t	LOGFT
log $f^{1}t$	LOGF1T
log $f^{1u}t$	LOGF1UT
L(n)	LN
L(p)	LP
L1	L1
L2	L2
L3	L3
L_1 x ray	XL1
L_2 x ray	XL2
L_3 x ray	XL3
L_l x ray	XLL
L_α x ray	XLA
L_β x ray	XLB
L_γ x ray	XLG
L x ray	XL
$L\alpha_1$ x ray	XLA1
$L\alpha_2$ x ray	XLA2
$L\beta_1$ x ray	XLB1
$L\beta_2$ x ray	XLB2

Translation	ENSDF
$L\gamma_1$ x ray	XLGl
$L\gamma_2$ x ray	XLG2
M	M
M x ray	XM
mb	MB
mb/sr	MB/SR
MEDLIST	MEDLIST
MeV	MEV
meV	MILLI-EV
mg/cm^2	MG/CM2
ms	MS
M1	M1
M2	M2
M3	M3
M4	M4
M5	M5
N	^N
NaI	NAI
NBS	NBS
nb / sr	NB/SR
NC^2S	NC2S
Ne	Ne
NMR	NMR
Note:	NOTE:
NQR	NQR
NSσ	NS*SIGMA
NX	NX
N-Z	N-Z
nγ	NG
nγγ	NGG
N×σ	N*SIGMA
O	O
odd-A	ODD-A
OSIRIS	OSIRIS
P	^P
PAC	PAC
PAD	PAD
PWBA	PWBA
PWIA	PWIA
p(θ)	P(THETA)
p–width	P-–WIDTH
pα	PALPHA
pγ	PG
pγγ	PGG
Q	MOME2
Q	Q
Q(g.s.)	QP
Q(α)	QA
$Q(\beta^-)$	Q–
Q(ε)	Q+_
Q+O	Q+O
Q3D	Q3D
R	R
RPA	RPA
RUL	RUL
r^2	R**2

ENSDF DICTIONARY— ordered by output

Translation	ENSDF
r_0	R0
S	^S
S value	S VALUE
SF	SF
Si(Li)	SILI
Sn	Sn
SOREQ	SOREQ
syst	SY
S'	S'
S(n)	SN
S(p)	SP
S(α)	SA
S-factor	S-FACTOR
S-value	S-VALUE
s-wave	S-WAVE
s^{-1}	S-1
T	ISPIN
T	TEMP
T	^T
th	TH
Ti	TI
tof	TOF
TPAD	TPAD
TRISTAN	TRISTAN
TRIUMPH	TRIUMPH
T20	T20
T21	T21
T22	T22
T_z	ISPINZ
$T_{1/2}$	T
tγ	TG
U	U
UNISOR	UNISOR
V	V
W	W
$w(\theta)g\Gamma_{\gamma 0}$	W(THETA)*G*WIDTHG0
W.u..	W.U.
X	^X
XX	XX
x-ray	X-RAY
Xγ	XG
Y	YTTRIUM
Y	^Y
Z	Z
%EWSR	%EWSR
%E0	%E0
%E2	%E2
%IT	%IT
%Iβ	%IB
%Iγ	%RI
%M1	%M1
%SF	%SF
$\%2\beta^-$	%2B–
$\%^{12}C$	%12C
$\%^{14}C$	%14C
%α	%A

Translation	ENSDF
$\%\beta^+$	%B+_
$\%\beta^+n$	%B+N
$\%\beta^+p$	%B+P
$\%\beta^+\alpha$	%B+A
$\%\beta^-$	%B–_
$\%\beta^-n$	%B-N
$\%\beta^-p$	%B-P
%ε	%EC
%εp	%ECP
%γ	%G
(fragment)γ	FG
(H,t)	(H,T)
(K x ray)γ	XKG
(t)	(T)
(α)	(A)
(α)(ce) ,	ACE
(α)(K x ray)	AXK
(β)	(B)
(θ,H)	(THETA,H)
(↑)	(UP)
(↓)	(DOWN)
2J	2J
$2\beta^-$	2B–
4π	4PI
4πβ	4PIB
4πβγ	4PIBG
4πγ	4PIG
<	LT
>	GT
°	DEG
$<r^2>$	AVRSQ
$\Delta<r^2>$	DAVRSQ
e.g.	E.G.
i.e.	I.E.
L	**L
-– 1	**–1
– 3	**–3
– 4	**–4
1 / 3	**1 / 3
$^{12}C\gamma$	C12G
α	ALPHA
α	CC
α decay	A DECAY
α syst	A SYST
α(exp)	ECC
α(K)	KC
α(K)exp	EKC
α(L)	LC
α(L)exp	ELC
α(L+…)exp	ELC+
α(L1)	L1C
α(L1)exp	EL1C
α(L2)	L2C
α(L2)exp	EL2C

ENSDF DICTIONARY— ordered by output

Translation	ENSDF
α(L3)	L3C
α(L3)exp	EL3C
α(M)	MC
α(M)exp	EMC
α(M+…)	MC+
α(M+…)exp	EMC+
α(M1)	M1C
α(M1)exp	EM1C
α(M2)	M2C
α(M2)exp	EM2C
α(M3)	M3C
α(M3)exp	EM3C
α(M4)	M4C
α(M5)	M5C
α(N)	NC
α(N)exp	ENC
α(N+…)	NC+
α(N+…)exp	ENC+
α(N1)	N1C
α(N2)	N2C
α(N2)exp	EN2C
α(N3)	N3C
α(N3)exp	EN3C
α-syst	A-SYST
αα	AA
αγ	AG
β	B
β	BETA
βc	BC
βce	BCE
βe^-	BE–
βn	BN
βp	BP
βR	B*R
β-vibrational	B-VIBRATIONAL
β^+	B+
β^-	B–_
β_L	BL
$\beta_L R$	BL*R
$\beta_L RA^{1/3}$	BL*R*A**(1/3)
β_0	B0
β_{12}	B12
β_1	B1
β_{20}	B20
β_{22}	B22
β_2	B2
$\beta_2 R$	B2*R
β_{30}	B30
β_3	B3
$\beta_3 R$	B3*R
β_{42}	B42
β_4	B4
$\beta_4 R$	B4*R
β_5	B5
β_6	B6
β_7	B7
βα	BA
ββ	BB
βγ	BG
βγn	BGN
βγγ	BGG
δ	MR
ΔA	DA
ΔA_2	DA2
ΔA_4	DA4
ΔE	DE
ΔI(γ+ce)	DTI
ΔIα	DIA
ΔIβ	DIB
ΔIε	DIE
ΔIγ	DRI
ΔIγ(%)	PRI
ΔJ	DJ
ΔJπ	DJPI
ΔK	DK
ΔL	DL
ΔQ(α)	DQA
ΔQ(ε)	DQ+
ΔS	DS
ΔSn	DSN
ΔS(p)	DSP
ΔT	DISPIN
$\Delta T_{1/2}$	DT
Δ(HF)	DHF
Δ(log *f*t)	DFT
Δ(β-normalization)	DNB
Δ(γ-normalization)	DNR
Δ	DELTA
δ^2	MR**2
Δα	DCC
Δδ	DMR
Δπ	DPI
ε	EC
ε	EPSILON
εB	EPSILONB
εB(E2)↑	EBE2UP
εB(E3)↑	EBE3UP
εK	CK
εK(exp)	ECK
εL	CL
εL(exp)	ECL
εM	CM
εN	CN
Φ	PHI
γ	G
γ	GAMMA
Γ	WIDTH
γce	GCE
γe–	GE–
γn	GN
γp'	GP'
γX	GX

ENSDF DICTIONARY— ordered by output

Translation	ENSDF
γ / α	G/A
Γ^2	WIDTH**2
$\Gamma^2_{\gamma 0}$	WIDTHG0**2
$\gamma^{\pm}$	G+–
Γ_{n0}	WIDTHNO
Γ_n	WIDTHN
$\Gamma_{p'}$	WIDTHP'
Γ_{p0}	WIDTHP0
Γ_{p1}	WIDTHP1
Γ_{p2}	WIDTHP2
Γ_p	WIDTHP
Γ_p	*WIDTHP
$\Gamma_{\gamma 0}$	WIDTHG0
Γ_γ	WIDTHG
Γ_α	WIDTHA
$\gamma\beta$	GB
$\gamma\gamma$	GG
$\gamma\gamma\gamma$	GGG
$\gamma\gamma\tau$	GGT
χ	CHI
χ^2	CHI**2
εM(exp)	ECM
εN(exp)	ECN
κ	KAPPA
λ	LAMBDA
μ	MOMM1
μ	MU
μb	UB
μb/s r	UB/SR
μb$\times$MeV	UB*MEV
μg	UG
μg/cm	UG/CM
μs	US
μ^-	MU–
ν	NU
π	PI
π^-	PI–
$\pi\beta$	PIB
$\pi\beta\gamma$	PIBG
$\pi\gamma$	PIG
θ	THETA
θ_1	THETA1
θ_2	THETA2
$\theta\gamma$	THETAG
ρ	RHO
ρ^2	RHO**2
σ	SIGMA
Σ	SUMOF
σ_n	SIGMAN
σ_0	SIGMA(0)
σ_γ	SIGMAG
σ_ν	SIGMANU
$\sigma\times\Delta E$	SIGMA*DE
τ	TAU
ω	OMEGA
$\omega^2\tau$	OMEGA**2*TAU
$\omega\tau$	OMEGA*T
ψ	PSI
$\times$	*
$\leq$	LE
$\neq$	NE
$\geq$	GE
$\approx$	AP
∞	INFNT

ENSDF	TRANSLATION
11/2(505)	11/2[505]
CONF=(N,NLJ)	configuration=(ν nlj)
CONF=((P,7/2(633))(P,3/2(521))(N,3/2(621))	configuration=((π 7/2[633])(π 3/2[521])(ν 3/2[621]))
CONF=(N,NLJ,–l)	configuration=(ν nlj)$^{-1}$
CONF=(N,1G9/2)	confieuration=(ν 1g$_{9/2}$)
CONF=(N,3G9/2,+3,23/2–)	configuration=(ν 3g$_{9/2}$)$^{+3}$23/2–
CONF=(N,3P1/2,–1)	configuration=(ν 3p$_{1/2}$)$^{-1}$
CONF=((208PB 3–)(P,1H9/2))15/2+	configuration=((^{208}Pb 3–)(π 1h$_{9/2}$))15/2+
CONF=(P,1G9/2)	configuration=(π 1g$_{9/2}$)
CONF=((P,1H9/2,+2,8+)(N,2F5/2,–3,11/2–))25/2–	configuration=((π 1h$_{9/2}^{2}_{8+}$(ν 2f$_{5/2}$)$^{-3}$$_{11/2-}$)25/2–
CONF=(P,3G9/2,+3,23/2–)	configuration=(π 3g$_{9/2}$)$^{+3}$23/2–

APPENDIX D-2

ENSDF DICTIONARY—ordered by input

ENSDF	Translation
A DECAY	α decay
A SYST	α syst
AA	αα
ACE	(α)(ce)
AG	αγ
ALPHA	α
AP	≈
AVRSQ	$<r^2>$
AXK	(α)(K x ray)
AY	Ay
A(THETA)	A(θ)
A**1/3	$A^{1/3}$
A**2/3	$A^{2/3}$
A–N	A–N
A–SYST	α-syst
A0	A_0
a 0	$a\ _0$
A1	A_1
A2	A_2
A2P2	A_2P_2
A2/A0	A_2/A_0
A22	A_{22}
A3	A_3
A4	A_4
B	β
BA	βα
BB	ββ
BC	βc
BCE	βce
Be	Be
BEL	B(EL)
BELW	B(EL)(W.u.)
BETA	β
BE(L)	BE(L)
BE–	βe^-
BE0	B(E0)
BE0W	B(E0)(W.u.)
BE1	B(E1)
BE1W	B(E1)(W.u.)
BE2	B(E2)
BE2UP	B(E2)↑
BE2W	B(E2)(W.u.)
BE3	B(E3)
BE3UP	B(E3)↑
BE3W	B(E3)(W.u.)
BE4	B(E4)
BE4UP	B(E4)↑
BE4W	B(E4)(W.u.)
BE5	B(E5)
BE5W	B(E5)(W.u.)
BE6	B(E6)
BE6W	B(E6)(W.u.)
BE7	B(E7)
BE8	B(E8)
BF3	BF_3
BG	βγ

ENSDF	Translation
BGG	βγγ
BGN	βγn
BGO	BGO
BJ**2	BJ^2
BL	β_L
BL*R	$\beta_L R$
BL*R*A**(1/3)	$\beta_L RA^{1/3}$
BML	B(ML)
BMLW	B(ML)(W.u.)
BM(L)	BM(L)
BM1	B(M1)
BM1W	B(M1)(W.u.)
BM2	B(M2)
BM2W	B(M2)(W.u.)
BM3	B(M3)
BM3W	B(M3)(W.u.)
BM4	B(M4)
BM4W	B(M4)(W.u.)
BM5W	B(M5)(W.u.)
BN	βn
BP	βp
BR	Branching
B(E0	B(E0
B(E1	B(E1
B(E2	B(E2
B(E3	B(E3
B(E4	B(E4
B(J	B(J
B*R	BR
B*RHO	B×ρ
B+	β^+
B–VIBRATIONAL	β–vibrational
B–	β^-
B0	β_0
B1	β_1
B12	β_{12}
B2	β_2
B2*R	$\beta_2 R$
B20	β_{20}
B22	β_{22}
B3	β_3
B3*R	$\beta_3 R$
B30	β_{30}
B4	β_4
B4*R	$\beta_4 R$
B42	β_{42}
B5	β_5
B6	β_6
B7	β_7
C	C
CC	α
CCBA	CCBA
CE	ce
CEB	ceβ
CEG	ceγ

ENSDF DICTIONARY—ordered by input

ENSDF	Translation
CEK	ce(K)
CEL	ce(L)
CEL1	ce(L1)
CEL2	ce(L2)
CEL3	ce(L3)
CEM	ce(M)
CEM1	ce(M1)
CEN2	ce(M2)
CEM3	ce(M3)
CEM4	ce(M4)
CEM5	ce(M5)
CEN	ce(N)
CEN1	ce(N1)
CEN2	ce(N2)
CEN3	ce(N3)
CEN4	ce(N4)
CEN5	ce(N5)
CE0	ce(0)
CE0+CEP	ce(0)+ce(P)
CERN	CERN
CHI	χ
CHI**2	χ^2
CK	εK
CL	εL
Cm	Cm
CM	εM
CM2	cm^2
CM3	cm^3
CN	εN
CO	Co
CONF	configuration
CONF=	configuration=
COS2TH	$\cos^2\theta$
COUL	Coul
CP	CP
CSI	CsI
C.M.	c.m.
C12G	$^{12}C\gamma$
C2S	C^2S
DA	ΔA
DAVRSQ	$\Delta\langle r^2\rangle$
DA2	ΔA_2
DA4	ΔA_4
DBR	branching uncertainty
DCC	Δα
DCO	DCO
DCOQ	DCOQ
DE	ΔE
DEG	°
DELTA	Δ
DE/DX	dE/dx
DFT	Δ(log *f*t)
DG	dγ
DHF	Δ(HF)
DIA	ΔIα
DIB	ΔIβ
DIE	ΔIε

ENSDF	Translation
DISPIN	ΔT
DJ	ΔJ
DJPI	ΔJπ
DK	ΔK
DL	ΔL
DMR	Δδ
DNB	Δ(β-normalization)
DNR	Δ(γ-normalization)
DOMEGA	dΩ
DPAC	DPAC
DPAD	DPAD
DPI	Δπ
DQA	ΔQ(α)
DQ+	ΔQ(ε)
DRI	ΔIγ
DS	ΔS
DSA	DSA
DSAM	DSAM
DSIGMA	dσ
DSN	ΔSn
DSP	ΔS(p)
DS/DW	dσ/dΩ
DT	$\Delta T_{1/2}$
DTI	ΔI(γ+ce)
DWBA	DWBA
DWIA	DWIA
DWUCK	DWUCK
D+Q	D+Q
D+(Q)	D+(Q)
D3HE	d^3He
E	E
EA	Eα
EAV	av Eβ
EB	Eβ
EBE2UP	εB(E2)↑
EBE3UP	εB(E3)↑
EC	ε
ECC	α(exp)
ECE	E(ce)
ECK	εK(exp)
ECL	εL(exp)
ECU	εM(exp)
ECN	εN (exp)
EDE	EΔE
EE	Ee
EEC	Eε
EG	Eγ
EG**5	$E\gamma^5$
EKC	α(K)exp
EL	EL
ELC	α(L)exp
ELC+	α(L+…)exp
BLlC	α(L1)exp
EL2C	α(L2)exp
EL3C	α(L3)exp
EMC	α(M)exp
EMC+	α(M+…)exp
EM1C	α(M1)exp

ENSDF DICTIONARY—ordered by input

ENSDF	Translation
EM2C	α(M2)exp
EM3C	α(M3)exp
EN	E(n)
ENC	α(N)exp
ENC+	α(N+…)exp
ENDOR	ENDOR
ENSDF	ENSDF
EN2C	α(N2)exp
EN3C	α(N3)exp
EP	E(p)
EPR	EPR
EPSILON	ε
EPSILONB	εB
ESR	ESR
EV	eV
EVEN-A	even-A
EWSR	EWSR
E'(THETA)	e'(θ)
E(A)	E(α)
E(D)	E(d)
E(E)	E(e)
E(N)	E(n)
E(P)	E(p)
E(T)	E(t)
E**1/2	$E^{1/2}$
E**2	E^2
E+	e^+
E-E	E-E
E.G.	e.g.
E/DE	E/ΔE
E0	E0
E1	E1
E2	E2
E3	E3
E4	E4
E5	E5
E6	E6
E7	E7
E8	E8
E9	E9
FG	(fragment)γ
FM	fm
FM**-1	fm^{-1}
FM**2	fm^2
FM**4	fm^4
FM-1	fm^{-1}
FWHM	FWHM
F-K	F-K
G	γ
GAMMA	γ
GB	γβ
GCE	γce
GDR	GDR
GE	≥
GEIGER	Geiger
GELI	Ge(Li)
GEV	GeV
GE–	γe^-
GG	γγ
GGG	γγγ
GGT	γγτ
GM	GM
GMR	GMR
GN	γn
CP'	γp'
GQR	GQR
GS	g.s.
GT	>
GTOL	GTOL
GT1/2	$gT_{1/2}$
GX	γX
G*T	gT
G*WIDTH	gΓ
G*WIDTHG0	$g\Gamma_{\gamma 0}$
G*WIDTHG0**2	$g\Gamma^2_{\gamma 0}$
G*W*WIDTHG0	$gw\Gamma_{\gamma 0}$
G+–	$\gamma^\pm$
G-FACTOR	g-factor
G/A	γ/α
HF	HF
Hl	Hl
HOMEGA	ħω
HPGE	HPGE
H**2	h^2
I	I
IA	Iα
IAR	IAR
IAS	IAS
IB	Iβ
IBA	IBA
IBS	IBS
IB+	$I\beta^+$
IB–	$I\beta^-$
ICE	Ice
IE	Iε
IG	Iγ
IG*EG	IγEγ
IMPAC	IMPAC
INFNT	∞
IPAC	IPAC
ISOLDE	ISOLDE
ISPIN	T
ISPINZ	T_z
IT DECAY	IT decay
I.E.	i.e.
J	J
JF	J_f
JI	J_i
JKP	JKπ
JMAX	Jmax
JMIN	Jmin
JOSEF	JOSEF

ENSDF DICTIONARY—ordered by input

ENSDF	Translation
JPI	Jπ
JULIE	JULIE
J0	J 0
J1	J 1
J2	J 2
K	K
KAPPA	κ
KC	α(K)
KEV	keV
KG	kG
KLL	KLL
KOE	kOe
KPI	Kπ
K/L+M	K/L+M
K/T	ce(K)/(γ+ce)
L	L
LAMBDA	λ
LAMPF	LAMPF
LARMOR	Larmor
LC	α(L)
LE	≤
LI	Li
LN	L(n)
LOGFT	log *f*t
LOGF1T	log f^{1}t
LOGF1UT	log f^{1U}t
LP	L(p)
LT	<
L/T	ce(L)/(γ+ce)
L1	L1
L1C	α(L1)
L2	L2
L2C	α(L2)
L3	L3
L3C	α(L3)
M	M
MB	mb
MB/SR	mb/sr
MC	α(M)
MC+	α(M+…)
MEDLIST	MEDLIST
MEV	MeV
MG/CM2	mg/cm^2
MILLI-EV	meV
MOME2	Q
MOMM1	μ
MR	δ
MR**2	δ^2
MS	ms
MU	μ
MU–	μ$^-$
M+/T	ce(M+)/(γ+ce)
M/T	ce(M)/(γ+ce)
M1	M1
M1C	α(M1)
M2	M2
M2C	α(M2)
M3	M3
M3C	α(M3)
M4	M4
M4C	α(M4)
M5	M5
M5C	α(M5)
NAI	NaI
NB	Iβ normalization
NBS	NBS
NB/SR	nb/sr
NC	α(N)
NC+	α(N+…)
NC2S	NC^{2}S
Ne	Ne
NE	≠
NC	nγ
NCG	nγγ
NMR	NMR
NOTE	Note
NQR	NQR
NR	Iγ normalization
NS-SIGMA	NSσ
NU	ν
NX	NX
N*SIGMA	N×σ
N+/T	ce(N+)/(γ+ce)
N-Z	N-Z
N1C	α(N1)
N2C	α(N2)
N3C	α(N3)
O	O
ODD-A	odd-A
OMEGA	ω
OMEGA*T	ωτ
OMEGA**2*TAU	ω^{2}τ
OSIRIS	OSIRIS
PAC	PAC
PAD	PAD
PALPHA	pα
PG	pγ
PGG	pγγ
PHI	φ
PI	π
PIB	πβ
PIBG	πβγ
PIG	πγ
PI–	π$^-$
PRI	ΔIγ(%)
PSI	ψ
PWBA	PWBA
PWIA	PWIA
P(THETA)	p(θ)
P-WIDTH	p-width
Q	Q
QA	Q(α)
QP	Q(g.s.)
Q+O	Q+O

ENSDF DICTIONARY—ordered by input

ENSDF	Translation
Q+_	Q(ε)
Q–	Q(β^-)
Q3D	Q3D
R	R
RHO	ρ
RHO**2	ρ^2
RI	Iγ
RPA	RPA
RUL	RUL
R**2	r^2
R0	r_0
S VALUE	S value
SA	S(α)
SF	SF
SIGMA	σ
SIGMAG	σ_γ
SIGMAN	σ_n
SIGMANU	σν
SIGMA(0)	σ_0
SIGMA*DE	σ×ΔE
SILI	Si(Li)
Sn	Sn
SN	S(n)
SOREQ	SOREQ
SP	S(p)
SUMOF	Σ
SY	syst
S'	S'
S-FACTOR	S-factor
S-VALUE	S-value
S-WAVE	s-wave
S-1	s^{-1}
T	$T_{1/2}$
TAU	τ
TEMP	T
TG	tγ
TH	th
THETA	θ
THETAG	θγ
THETA1	θ_1
THETA2	θ_2
TI	I(γ+ce)
Ti	Ti
TOF	tof
TPAD	TPAD
TRISTAN	TRISTAN
TRIUMPH	TRIUMPH
T20	T20
T21	T21
T22	T22
U	U
UB	μb
UB*MEV	μb×MeV
UB/SR	μb/sr
UC	μg
UG/CM	μg/cm
UNISOR	UNISOR

ENSDF	Translation
US	μs
V	V
W	W
WIDTH	Γ
WIDTHA	Γα
WIDTHG	Γ_γ
WIDTHG0	$\Gamma_{\gamma 0}$
WIDTHG0**2	$\Gamma^2_{\gamma 0}$
WIDTHN	Γ_n
WIDTHN0	Γ_{n0}
WIDTHP	Γ_p
WIDTHP'	$\Gamma_{p'}$
WIDTHP0	Γ_{p0}
WIDTHP1	Γ_{p1}
WIDTHP2	Γ_{p2}
WIDTH**2	Γ^2
W(THETA)*G* WIDTHG0	$w(\theta)g\Gamma_{\gamma 0}$
W.U.	W.u.
XG	Xγ
XK	K x ray
XKA	Kα x ray
XKA1	$K\alpha_1$ x ray
XKA2	$K\alpha_2$ x ray
XKB	Kβ x ray
XKB1	$K\beta_1$ x ray
XKB1P	$K\beta_{1'}$ x ray
XKB2	$K\beta_2$ x ray
XKB2P	$K\beta_{2'}$ x ray
XKB3	$K\beta_3$ x ray
XKB4	$K\beta_4$ x ray
XKB5	$K\beta_5$ x ray
XKB5I	$K\beta_5^{I}$ x ray
XKB5II	$K\beta_5^{II}$ x ray
XKG	(K x ray)γ
XKO2	K-O_2 x ray
XKO23	K-O_{23} x ray
XKO3	K-O_3 x ray
XL	L x ray
XLA	L_α x ray
XLA1	$L\alpha_1$ x ray
XLA2	$L\alpha_2$ x ray
XLB	Lβ x ray
XLB1	$L\beta_1$ x ray
XLB2	$L\beta_2$ x ray
XLG	Lγ x ray
XLG1	$L\gamma_1$ x ray
XLG2	$L\gamma_2$ x ray
XLL	L_l x ray
XL1	L_1 x ray
XL2	L_2 x ray
XL3	L_3 x ray

APPENDIX D-2 (cont.)

ENSDF DICTIONARY—ordered by input

ENSDF	Translation
XM	M x ray
XX	XX
X-RAY	x-ray
YTTRIUM	Y
Z	Z
%A	%α
%B+A	%$\beta^+\alpha$
%B+N	%β^+n
%B+P	%β^+p
%B+_	%β^+
%B-N	%β^-n
%B-P	%β^-p
%B–	%β^-
%EC	%ε
%ECP	%εp
%EWSR	%EWSR
%E0	%E0
%E2	%E2
%G	%γ
%IB	%Iβ
%IT	%IT
%M1	%M1
%RI	%Iγ
%SF	%SF
%12C	%^{12}C
%14C	%^{14}C
%2B-	%2β^-
(A)	(α)
(B)	(β)
(DOWN)	($\downarrow$)
(H,T)	(H,t)
(THETA,H)	(θ,H)
(T)	(t)
(UP)	($\uparrow$)
*	$\times$
*G*WIDTHG0**2	g$\Gamma^2_{\gamma 0}$
*WIDTHP	Γ_p
**L	L
**–1	–1
**–3	–3
**–4	–4
**1/3	1/3
2B–	2β^-
2J	2J
4PI	4π
4PIB	4$\pi\beta$
4PIBG	4$\pi\beta\gamma$
4PIG	4$\pi\gamma$
^A	A
^B	B
^D	D
^N	N
^P	P
^S	S
^T	T
^X	X
^Y	Y

ENSDF	TRANSLATION
11/2(505)	11/2[505]
CONF=(N,NLJ)	configuration=(ν nlj)
CONF=((P,7/2(633))(P,3/2(521))(N,3/2(621))	configuration=((π 7/2[633])(π 3/2[521])(ν 3/2[621]))
CONF=(N,NLJ,–1)	configuration=(ν nlj)$^{-1}$
CONF=(N,1G9/2)	configuration=(ν 1g$_{9/2}$)
CONF=(N,3G9/2,+3,23/2–)	configuration=(ν 3g$_{9/2}$)$^{+3}$23/2–
CONF=(N,3P1/2,–1)	configuration=(ν 3p$_{1/2}$)$^{-1}$
CONF=((208PB 3–)(P,1H9/2))15/2+	configuration=((^{208}Pb 3–)(π 1h$_{9/2}$))15/2+
CONF=(P,1G9/2)	configuration=(π 1g$_{9/2}$)
CONF=((P,1H9/2,+2,8+)(N,2F5/2,–3,11/2–))25/2–	configuration=((π 1h$_{9/2}^{2}_{8+}$(ν 2f$_{5/2}$)$^{-3}$$_{11/2–}$)25/2–
CONF=(P,3G9/2,+3,23/2–)	configuration=(π 3g$_{9/2}$)$^{+3}$23/2–

APPENDIX E

DATA EVALUATION CENTERS

a. National Nuclear Data Center
Brookhaven National Laboratory
Upton, NY 11973, U.S.A.
Contact: J. K. Tuli

b. Nuclear Data Project
Oak Ridge National Laboratory
Oak Ridge, TN 37831, U.S.A.
Contact: M. J. Martin

c. Isotopes Project
Lawrence Berkeley Laboratory
Berkeley, CA 94720, U.S.A.
Contact: E. Browne/R. B. Firestone

d. Idaho National Engineering Laboratory
E.G. and G. Idaho, Inc.
P.O. Box 1625
Idaho Falls, ID 83415, U.S.A.
Contact: C. W. Reich

e. Physics Department
University of Pennsylvania
Philadelphia, PA 19174, U.S.A.
Contact: F. Ajzenbere-Selove

f. Center for Nuclear Structure
and Reaction Data of the U.S.S.R.
State Committee on the Utilization
of Atomic Energy U.S.S.R.
46 Ulitsa Kurchatova
Moscow, D-182, U.S.S.R.
Contact: P. E. Chukreev

g. Data Centre
Leningrad Nuclear Physics Institute
Gatchina, Leningrad Region
188350, U.S.S.R.
Contact: I. A. Kondurov

h. Fysisch Laboratorium
Princetonplein 5, Postbus 80.000
3508 TA Utrecht, The Netherlands
Contact: C. van der Leun

i. Fachinformationszentrum Energie,
Physik, Mathematik GmbH
Kernforschungszentrum
D-7514 Eggenstein-Leopoldshafen 2
F.R.G.
Contact: H. Behrens

j. Centre d'Études Nucléaires
DRP-CPN
Cedex No. 85
F-38041 Grenoble Cedex, France
Contact: J. Blachot

k. Division of Physics
Japan Atomic Energy Research Institute
Tokai-Mura, Naka-Gun
Ibaraki-Ken 319-11, Japan
Contact: T. Tamura

l. Institute of Physics
University of Lund
Solvegatan 14
S-223 62 Lund, Sweden
Contact: P. Ekström

m. Nuclear Data Project
Kuwait Institute for Scientific Research
P.O. Box 24885
Kuwait, Kuwait
Contact: S. Rab

n. Laboratorium voor Kernfysica
Proeftuinstraat 86
B-9000 Gent, Belgium
Contact: D. De Frenne

o. Tandem Accelerator Laboratory
McMaster University
Hamilton, Ontario L8S 4Kl
Canada
Contact: J. A. Kuehner

p. Institute of Atomic Energy
P.O. Box 275 (41), Beijing,
People's Republic of China
Contact: C. Dunjiu

EVALUATION RESPONSIBILITY

A-Range	Center	A-Range	Center	A-Range	Center	A-Range	Center
1-4	f	65-73	a	136-148	a	195-198	p
5-20	e	74-80	m	149,151	o	199-237	b
21-44	h	81-100	i	150,152	a	238-244(even)	f
45-50	a	101-110	j	153-162	d	239-243(odd)	b
51-56	p	111-117	n	163,165	a	245-263	b
57,58	a	118-129	k	164,166	f		
59-64	1	130-135	g	167-194	c		

APPENDIX F

Conventions, Policies and Symbols in *Nuclear Data Sheets*

LANGUAGE STYLE IN NUCLEAR DATA SHEETS

The *Nuclear Data Sheets* generally follow the language guidelines as contained in the *American Institute of Physics Style Manual* (AIP Publ. R-283, 1978). Some specific suggestions on punctuation, abbreviations, spelling, and grammar, as well as a discussion of some common problems follow:

a. <u>Abbreviations</u>*:* Use the standard abbreviations given in Appendix F-5 and the inside back cover of the journal. For example, use "excit" instead of "exc," "exp" instead of "expt," etc. Use periods with abbreviations only if given on the list. Abbreviations such as av, calc, norm, pol, rel, res, etc. should not be used in the regular text. They are intended for use in tables, equations, parenthetical expressions, reactions, etc. to conserve space.

b. <u>Keynumber</u>*s:* Keynumbers should be treated as plural subjects since, for example, "81Aa99 are continuing ..." is the same as "The authors of 81Aa99 are continuing..." Keynumbers in series should be in either descendine (preterred) or ascendine chronological, alphabetical, and numerical order. This should be consistent throughout an evaluation.

c. <u>Tense</u>*:* Past-tense verbs should be used for events which have already taken place and are not ongoing. For example "81Aa99 measured..." instead of 81Aa99 measure..." However, "81Ba12 cite..."

d. <u>Spelling</u>*:* When there are two or more correct spellings of a word, use the short or American spelling. For example, "analog" instead of "analogue," "behavior" instead of behaviour," "polarization" instead of polarisation." However, "thru,","tho," and other simplified spellings, slang, or jargon should not be used. Under l(vi) below, there is a list of some words that are always spelled solid and others that are always hyphenated. Use standard rules for hyphenating compound modifiers. Appendix B of the *AIP Style Manual* contains additional examples of the preferred spellings of words which occur frequently. *Webster's Instant Word Guide* is a very useful source for both the spelling and the hyphenation of words.

e. <u>Commas</u>*:* A comma precedes the conjunction before the final item in a series, unless the conjunction joins combinations. This rule would also apply to the semi-colon when used in a series. In comments listing level energy and Jπ, set off the Jπ with commas as an appositive. For example:

1981.3, (1-,2-), is given

1993.5, 1, is given.

In a series, use semicolons after all but the last Jπ (comma before conjunction). For example, 1981.3, (1-, 2-); 1992.4, 3-, 5-; and 1993.5, 1, are given.

Key numbers in comments are separated by commas immediately followed by a space. However, key numbers on formatted or continuation records or key numbers enclosed in parentheses are separated by a comma without a following blank.

f. <u>Person:</u> Smooth transitions between first and third person are acceptable.

g. <u>Units:</u> With the exception of the four standard units tor energy, cross section, and electric and magnetic moments as given under the "Conventions used in Nuclear Data Sheets," appropriate units, as defined in Appendx F-5 should be given tor all quantities. In eeneral, the unit should appear between the value and associated uncertainty. For example, Tl/2 = 13.3 min 5. There are a few exceptions where the unit is associated with the quantity measured or deduced. For example, B(E2)(W.u.)=l.0 1, instead of B(E2)=1.0 W.u. 1.

h. <u>Mathematical operators and equation</u>*s:* The following operators are allowed within the text: +–, =, <, >, LT, GT, LE, NE, AP. The production programs will remove the leading and trailing blanks around the operators, thus compacting an equation. The representation of complex equations often causes problems. The evaluator can code these in comments usinit the special characters as defined in Appendix A-1. If you are not sure of the proper use of special characters, write down the formula in a note to NNDC and the production staff will try to code it for you.

LANGUAGE STYLE IN NUCLEAR DATA SHEETS (cont..)

i. Miscellaneous:

(i) Use "spin and parity" instead of "spin-parity."

(ii) Use "uncertainty" instead of "error" unless "error" means "mistake."

(iii) If a number contains a decimal point, there must be a number before the decimal point ("0.99" instead of ".99").

(iv) Use the form “0.99 9” instead of “0.99±9” or “o.99±0.09” for uncertainties.

(v) When foreign words are used, the appropriate number should be reflected in the verb and modifiers. One of the most widely used word in this category is the Latin singular word "datum," whose plural is "data." Singular "This datum is ..." would have the plural "These data are..."

(vi) Some single words:

antianalog	depopulation	nonstatistical
antiparallel	endpoint	nonuniform
bandhead	lifetime	nonunique
backbending	lineshape	overall
backscat-ter	nonaligned	photopeak
crossover	nonelastic	pickup (adj.)
cutoff (adj.)	nonlocal	subshell
deadline	nonresonant	wavelength
deexcitation	nonrotational	

Some hyphenated words (Modifiers made up of two or more words are usually hyphenated)

di-pion	l-no shape	half-life
2-yes shape	half-width	96-keV level
mean-life	s-wave capture	non-negative
shell-model calculations	non-Fermi	x-ray intensity
quasi-free-electron	self-consistent	semi-infinite
up-spin		

The following are spelled as two words:

cross section
shell model
wave function
x ray
α particle
γ ray

GENERAL POLICIES — "THEORY"

A reference "Theory 67Xy01" indicates theoretical predictions computed by the authors of 67Xy01. A reference "Theory" alone indicates a determination by the compiler of theoretical predictions described below.

Internal Conversion Coefficients

Theoretical conversion coefficients are obtained by spline interpolation (68Ha53) from tables of Hager and Seltzer (68Ha53) for the K-, $L_{1\ldots3}$-, $M_{1\ldots5}$-shells and of Dragoun, Plajner, and Schmutzler (71Dr11) for the (N+O+...)-shells. For the $N_{1\ldots5}$-subshells, values are obtained by graphical interpolation from tables of Dragoun, Pauli, and Schmutzler (69Dr09). For K-, $L_{1\ldots3}$-shells, conversion coefficients for transitions outside the E_γ, Λ-, or Z-ranges of Hager and Seltzer are obtained as follows: for $E_\gamma \le 6000$ keV and for Z=3, 6, 10 and $14 \le Z \le 30$ interpolation from tables of Band et al. (76Ba63); for $E_\gamma > 2600$ keV, by graphical interpolation from tables of Trusov (72Tr09). For E0-transitions, K/L_1 and L_1/L_2 ratios are obtained by graphical interpolation from tables of Hager and Seltzer (69Ha61).

Angular Distribution and Correlation Coefficients

The coefficients required for analysis of directional correlation, polarization correlation, directional distribution, and polarization distribution data are obtained as described by Steffen (71St47, 71St48). In particular, we adopt the phase convention for the mixing ratio, δ, defined by the authors (70Kr03). Particle parameters required for the analysis ofcorrelation and distribution data involving conversion electrons are obtained by graphical interpolation from tables of Hager and Seltzer (68Ha54). The expression for the deorientation coefficient required to account for intermediate unobserved mixed radiations is given by Anicin (72An20).*

A tabulation of gamma-gamma directional coefficients is given by Taylor, et al. (71Ta32). These authors use the Steffen phase convention.

Penetration Parameters

Penetration parameters required for the analysis of internal conversion data and angular correlation or distribution data involving electrons are obtained by graphical interpolation from tables of Hager and Seltzer (69Ha61).

InternalPairConversionCoefficients
Theoretical internal pair conversion coefficients for A=E1, M1, E2 are obtained by graphical interpolation in Z, E from tables of Lombard, et al. (68Lo16).

* As pointed out by these authors, most earlier references which discuss this coefficient define it incorrectly

β-Decay Rate Probabilities

Log*f*t values, capture-to-positron ratios, and electron-capture ratios for allowed, first-forbidden unique, and second-forbidden unique transitions are obtained as described by Gove and Martin (71Go40). This reference also contains a tabulation of log *f* values and total capture-to-positron ratios for allowed and first-forbidden unique transitions.

Atomic Processes

X-ray fluorescence yields are obtained from Bambynek et al. (72Bb16) for $Z \le 92$ and from Ahmad (79Ah01) for Z>92.

Electron binding energies for Z<84 are taken from Bearden and Burr (67Be73) and from Porter and Freedman (78Po08) for Z>84.

α–Decay Hindrance Factors

The α-hindrance factors (the ratio of the measured partial half-life for α-emission to the theoretical half-life) are obtained from the spin-independent equations of Preston (47Pr17). The nuclear radius for each even-even nucleus was determined by defining, for the g.s. to g.s. α-transition hindrance factor, HF≡1. For odd-A and odd-odd nuclei, the radius was chosen to be the average of the radii for the adjacent even-even nuclei (72El21). In the few cases where only one adjacent even-even radius was known, that value was corrected for the $A^{1/3}$ mass dependence and used in the calculation.

Electromagnetic Transition Rates

The Weisskopf single-particle estimates for the half-lives of electric and magnetic multipole radiation of energy E_γ are (62B19)

$$T_{1/2W}(\mathrm{EL}) = 0.190\left(\frac{L}{L+1}\right)\left(\frac{3+L}{3}\right)^2 \frac{[(2L+1)!!]^2}{A^{2L/3}} \left(\frac{164.44}{E_\gamma(\mathrm{MeV})}\right)^{2L+1} \times 10^{-21}\,\mathrm{s}$$

$T_{1/2W}(\mathrm{ML}) = 3.255\ A^{2/3}\ T_{1/2w}(\mathrm{EL})$
for nuclear radius $1.2\ A^{1/3} \times 10^{-13}$ cm.

Unweighted and Weighted Averages
If $x_1 \pm \Delta x_1$, $x_2 \pm \Delta x_2$, … $x_n \pm \Delta x_n$ are n independent measurements of a given quantity, .Δx_i being the uncertainty in x_i, then the weighted average of these measurements is $\bar{x} \pm \Delta\bar{x}$, where

$$\bar{x} = W\Sigma x_i/(\Delta x_i)^2,$$
$$W = 1/\Sigma(\Delta x_i)^{-2},$$

and $\Delta\bar{x}$ is the larger of

$$(W)^{1/2}$$

and $[W\Sigma(\Delta x_i)^{-2}(\bar{x}-x_i)^2/(n-1)]^{1/2}$.

The unweighted average of these same measurements is given by $\bar{x} \pm \Delta\bar{x}$, where

$$\bar{x} = \Sigma x_i/n,$$
$$\Delta\bar{x} = [\Sigma(\bar{x}-x_i{}^2/n(n-1)]^{1/2}$$

GENERAL POLICIES—"THEORY" (cont'd)

Reference

47Pr17 M. A. Preston—*Phys. Rev.* 71, 865 (1947); The Theory of Alpha Radioactivity

52Bl97 J. M. Blatt, V. F. Weisskopf—*Theoretical Nuclear Physics*, John Wiley and Sons, Inc., New York, p. 627 (1952)

58Ro60 M. E. Rose—*Internal Conversion Coefficients*, North-Holland Publishing Co., Amsterdam (1958)

67Be73 J. A. Bearden, A.F. Burr—*Rev. Mod. Phys.* 39, 125 (1967); Reevaluation of X-Ray Atomic Energy Levels

68Ha53 R. S. Hager, E. C. Seltzer—*Nucl. Data* A4, 1 (1968); Internal Conversion Tables. Part I: K-, L-, M-Shell Conversion Coefficients for Z=30 to Z=103

68Ha54 R. S. Hager, E. C. Seltzer—*Nucl. Data* A4, 397 (1968); Internal Conversion Tables. Part II: Directional and Polarization Particle Parameters for Z=30 to Z=103

68Lo16 R. J. Lombard, C. F. Perdrisat, J. H. Brunner—*Nucl. Phys.* A110, 41 (1968); Internal Pair Formation and Multipolarity of Nuclear Transitions

69Dr09 O. Dragoun, H. C. Pauli, F Schmutzler—*Nucl. Data Tables* A6, 235 (1969); Tables of Internal Conversion Coefficients for N-Subshell Electrons

69Ha61 R. S. Hager, E. C. Seltzer—*Nucl. Data Tables* A6, 1 (1969); Internal Conversion Tables. Part III: Coefficients for the Analysis of Penetration Effects in Internal Conversion and E0 Internal Conversion

70Kr03 K. S. Krane, R. M. Steffen—*Phys. Rev.* C2, 724 (1970); Determination of the E2/M1 Multipole Mixing Ratios of the Gamma Transitions in Cd^{110}

71Dr11 O. Dragoun, Z. Plajner, F. Schmutzler - Nucl. Data Tables A9, 119 (1971); Contribution of Outer Atomic Shells to Total Internal CinversionCoefficients.

71Go40 B. Gove, M. J. Martin—*Nucl. Data Tables* A10, 205 (1971); Log-f Tables for Beta Decay

71St47 R. M. Steffen—*Angular Distributions and Correlations of Radiation Emitted from Oriented Nuclei*; Report LA-4565-MS, Los Alamos Scientific Laboratory (1971)

71St48 R. M. Steffen—*Proc. Int. Conf. Angular Correlations in Nuclear Disintegration*, Delft, Netherlands (1970), H. van Krugten , B. van Nooijen, Eds., Wolters-Noordhoff Publ., Groningen, p. 1 (1971); Angular Distributions and Correlations of Nuclear Radiations in Nuclear Spectroscopy

71Ta32 W. H. Taylor, B. Singh, F. S. Prato, R. McPherson—*Nucl. Data Tables* A9, No. 1, 1 (1971); A Tabulation of Gamma-Gamma Directional-Correlation Coefficients

72An20 I.V.Anicin,R.B.Vukanovic,A.H.Kukoc—*Nucl. Instrum.Methods*103,395(1972);TheNew Instrum. of 1-3 Directional Correlations with MixedUnobservedTransitions

72Bb16 W. Bambynek, B. Crasemann, R. W. Fink, H.-U. Fruend,H. Mark, C. D. Swift, R. E. Price, P. Venugopala Rao—*Rev. Mod. Phys.* 44, 716 (1972); X-Ray Fluorescence Yields, Auger, and Coster–Kroni Transition Probabilities

72El21 Y. A. Ellis, M. R. Schmorak—*Nucl. Data Sheets* B8,345 (1972); Survey of Nuclear Structure systematics for A ≥ 229

72Tr09 V. F. Trusov—*Nucl. Data Tables* 10, 477(1972); EnergyTransitions

76Ba63 I. M. Band, M. B. Trzhaskovskaya, M. A. Listengarten *Nucl. Data Tables* 18, 433 (1976); Internal Conversion Coefficients for Atomic Numbers $Z^{\leq 30}$

78Po08 F. T. Porter and M. S. Freedman —*J. Phys. Chem. Ref.Data* 7, 1267 (1978); Recommended AtomicElectron Binding Energies, 1s to $6p_{3/2}$forHeavyElements, Z=84 to 103

79Ah0l I. Ahmad—*Z. Phys.* A290, 1 (1979); Precisio measurement of K-Shell FluorescenceYieldsin

ORGANIZATION OF MATERIAL

Within each A chain, information is collected by isotope and arranged in order of increasing Z. For each isotope, ^{A}Z, the arrangement of material and conventions for inclusion in tables are described below. Uncertainties are shown whenever available.

1. Adopted levels in ^{A}Z — All adopted level properties are shown for each level, together with explanatory comments.
2. Adopted γ radiations in ^{A}Z.
3. Radiations from ^{A}Z decay — All adopted radiation properties are shown for each mode of decay of the ^{A}Z ground state. Properties of α, β^-, AND $\varepsilon+\beta^+$ radiations precede γ-radiation properties.
4. Radiations from ^{A}Z isomeric-state decay — Decay of each isomeric state is presented according to the same conventions as for the ground-state decay.
5. Levels and γ rays in ^{A}Z from decay† — Decays are ordered by A, Z of the parent.
   a) Table of levels deduced from the decay.
   b) Table of γ rays observed in the decay unless given under its respective parent according to 3 or 4 above.
6. Levels and γ ray s in ^{A}Z from nuclear reactions† — Reactions are ordered by A, Z of the target, then by A, Z of the incident nucleus. A heading is given for each reaction.
   a) Table of levels deduced from the reaction.
   b) Table of γ rays observed in the reaction.

† The detailed results are tabulated only when the information is not adequately summarized on the drawings.

SUMMARY OF BASES FOR SPIN AND PARITY ASSIGNMENTS -continued

PROPOSITIONS ON WHICH STRONG ARGUMENTS ARE BASED

Ground States

1. The ground state of an even-even nucleus has $J^{\pi}=0^{+}$.

2. Spin determinations by such techniques as atomic-beam resonance, paramagnetic resonance, electron-spin resonance, and optical spectroscopy give correct values.

Gamma Transitions

3. The agreement of the measured value of a single conversion coefficient with the theoretical value for a multipolarity which is well separated from the value for any other multipolarity determines the transition multipolarity.

4. In all other cases if there is no other evidence for multipolarity, agreement of two or more measured conversion coefficients or ratios with theoretical values is necessary in order to establish the multipolarities of a transition and its mixing ratio.

5. Since E0 transitions can proceed only by conversion or pair production, pure E0 is ruled out if photons are observed.

6. Recommended upper limits for γ-ray strengths (Γ_γ / Γ_w, Γ_w –Weisskopf estimate) for various A-values are given below

$\Gamma\gamma / \Gamma w$(Upper Limit))

Character*	A=6-44[a§]	A=45-150[a,b]	A>150[c]
E1 (IV)	0.3[#]	0.01	0.01
E2 (IS)	100	300	1000
E3	100	100	100
E4	100	100[†]	
M1 (IV)	10	3	2
M2 (IV)	3	1	1
M3 (IV)	10	10	10
M4		30	10

* IV' and 'IS' stand for isovector and isoscalar.

† Γ_γ/Γ_W(Upper Limit)=30 for A=90-150

\# Γ_γ/Γ_W(Upper Limit)=0.1 for A=21-44

§ Γ_γ/Γ_W(Upper Limit)=0.003 for E1 (IS), 10 for E2 (IV), 0.03 for M1 (IS), 0.1 for M2 (IS)

a From 79EnO4

b From 81EnO6

c Deduced from ENSDF by M. J. Martin

Beta Transitions§

7a. If 3.6<log *ft*<5.9, the transition is allowed: ΔJ=0 or 1, Δπ=+ (no change in parity). For the mass region around Z=82, the upper limit should be lowered to 5.1.

See "β-Decay Rate Probabilities" on page App-F-iv. Note that log $f^{u}t$=log f't+l.079).

∗ (log f't < 7.4)

† (log f't ≥ 7.4)

7b. If 3.6<log *ft*<6.4, the transition is not $0^+\rightarrow0^+$. Superallowed (ΔT=0) $0^+\rightarrow0^+$ transitions have log *ft* in the range 3.48 to 3.50. Isospin forbidden (ΔT=1). $0^+\rightarrow0^+$ transitions have log *ft*>6.4.

8. If log $f^{u}t$<6.5,* ΔJ=0,1; Δπ=±.

9. If log *ft*<11.0, ΔJ=0,1, Δπ=± or ΔJ=2, Δπ=–

10. If log *ft*<12.8, ΔJ=0,1,2; Δπ=±.

11. If log $f^{u}t$≥8.5† and if the Fermi plot has the curvature corresponding to a shape factor (p^2+q^2), then the transition is first-forbidden unique (ΔJ=2, Δπ=–).

γγ Directional Correlation

$$W(\theta) = \sum_{k-\text{even}} A_k P_k(\cos\theta)$$

12. If a gamma-gamma directional-correlation experiment yields $A_2\approx+0.36$ and $A_4\approx+1.1$, then the spin sequence is $0\rightarrow2\rightarrow0$.

13. Results of γγ(θ) are strong evidence for excluding spin sequences for which the theoretical A_2 or A_4 falls well outside the experimental range.

βγ Directional Correlation

$$W(\theta) = \sum_{k-\text{even}} A_k(\beta) A_k(\gamma) P_k(\cos\theta).$$

14. If $|A_2(\beta)|\geq0.1(A_4=0)$, the transition is not allowed. The converse is not true.

15. If $A_4(\beta)\neq0$, the transition is neither allowed nor first-forbidden.

16. If $A_4(\beta)=0$, the transition is allowed or first-forbidden.

βγ Polarization Correlation

$$P(\theta) = \frac{\sum_{k-odd} A_k(\beta) A_k(\gamma) P_k(\cos\theta)}{W(\theta)}$$

17. In allowed transitions,

β^- $A_1(\beta)<0$ if $J_i=J_f$

β^+ $A_1(\beta)>0$ if $J_i=J_f$

β^- $A_1(\beta)\leq0$ if $J_i=J_f+1$
$A_1(\beta)<0$ if $J_i=J_f-1$

β^+ $A_1(\beta)\leq0$ if $J_i=J_f+1$
$A_1(\beta)>0$ if $J_i=J_f-1$

18. If $A_3(\beta)\neq0$, the β-transition is not allowed. The converse is
noalwaystrue..

SUMMARY OF BASES FOR SPIN AND PARITY ASSIGNMENTS -continued

Reactions

19. Low-energy Coulomb excitation is predominantly E2 excitation.

20. Coulomb excitation determines $J^{\neq}$ if the excitation probability agrees with the calculated values of Alder et al., Kgl. . Danske Videnskab. Selskab, Mat.-Fys. Medd. 32, No. 8 (1960).

21. Tbe spin of the compound nuclear state resulting from thermal-neutron capture is equal to the spin of the target nucleus plus or minus 1/2.

22. Primary γ's from neutron capture are E1, M1, E2, or M1+E2.

23. If the angular distribution in a single-nucleon transfer reaction can be fitted with a unique *l*-value, the spin of the final state J_f is related to the spin of the inital state J_i by

$$\vec{J}_f = \vec{J}_i + \vec{l} + \vec{1/2}$$

with parity change ir *l* is odd.

24. For Z<≈50 and Z≈82, if the vector analyzing power for a single-nucleon transfer r eaction shows a clear preference between J=*l*+1/2 and J = *l*–1/2 and if the *l*-value is known, then the J-value is determined.

The limitation in the regions of applicability results from a lack of measurements in other regions rather than an expected or observed violation.

25. If the angular distribution can be fitted with a unique L-value the J^π of the final state is related to the J^π of the initial state by

$$\vec{J}_f = \vec{J}_i + \vec{L}, \qquad \pi_f \pi_i = (-1)^L,$$

for the following cases:

a. A strong group observed in (p,t), (t,p), and (3He,n) reactions (strong groups are assumed to result from two identical nucleons transferred in a relative s-state)
b. A strong group observed in the α-particle reaction (^{6}Li,d).
c. (e,e') and (α,α’) inelastic scattering.

26. In reactions with $J^\pi = 0^+$ target, projectile, and ejectile, if the yield of a group at 0° or 180° is

a. non-zero, the parity of the final state is $(-l)^{Jf}$
b. zero at several uncorrelated energies, the parity of the final state is $(-1)^{Jf+1}$

In reactions with a polarized J^π=1 projectile in the m=0 substate, with $J^\pi = 0^+$ ejectile and target, if the yield of a eroup at 0° or 180° is

a. non-zero, the parity of the final state is $(-1)^{Jr+1}$
b. zero at several uncorrelated energies, the parity of the final state is $(-1)^{Jr}$.

§ See 73 Ra 10

Magnetic Moments

27. In nonrotational regions, if the known spin and magnetic moment of a level lead to an expected shell-model state by use of the Schmidt diagram, the level parity is.determined.

28. In rotational regions, if the known spin and magnetic moment of a level agree with theoretical values for only one expected Nilsson level, the level parity is determined.

Deformed Region—Band Structure

Symbol	Evidence
D	Data from β- or γ-transitions suggest $J^\pi = 2^+$
x	The level is Coulomb excited
y	The level energy is given by the rotational level-energy formula
z,z'	The inertial parameter, decoupling parameters, fits the local trend

In terms of the above types of evidence, the following rules can be stated for nuclei in the rotational regions. 90≤N≤112 and Z>87.

29. For the first excited state in an even-even nucleus, x or Dz is sufficient to assign a spin and parity of 2^+.

30. A level may be assigned to the ground-state rotational band on evidence of type xz or yz, provided the ground-state spin is well known.

31. A level may be assigned to a rotational band on evidence of type yz, provided at least one member of the band has well-known spin.

32. For K=1/2 bands, yz' is sufficient evidence to assign spins to the levels.

Alpha Decay

33. In odd-A nuclei, levels connected by α-transitions have the same spin and parity if the hindrance factor is less than 4.

34. For α-decay between two states, one of which has J=0, the parity change is given bv $\Delta\pi = (-1)^{\Delta J}$.

SUMMARY OF BASES FOR SPIN AND PARITY ASSIGNMENTS -continued

PROPOSITIONS ON WHICH WEAK ARGUNENTS ARE BASED

1. In cases where gammas of one multipolarity "cluster" in one time region in the half-life vs. energy plot, as is true for M4's, other γ's whose half-lives fall in this cluster may be assigned the corresponding multipolarity.

2. In cases where a cluster of two multipolarities occupy one time region, e.g. M1 and E2, a new gamma of which the half-life falls in this region may be assigned one of the two multipolarities or a mixture of the two.

3. Whenever $\Delta J \geq 2$, an appreciable part of the Gamma transition proceeds by the lowest possible multipole order. This statement is based on the scarcity or counter-examples and the observation that few E2 γ's are as slow as M3's, few M2's as slow as B3's, etc.

4. Low-lying states of odd-A nuclei have shell-model spins and parities except in the regions where deformations appear. This argument is much stronger when supported by expected cross-section strengths (C^2S) in single-nucleon transfer reactions. It is recognized that some shell modelpredictions are stronger than others. For example, the shell model would mildly deny that the ground-state J^{π} of the 39th proton be $3/2^-$ but emphatically deny its being $3/2^+$. However, we have not included this distinction here and consider that all shell-model arguments are weak.

5. The spin and parity of a parent state may be inferred from the measured properties of its assumed isobaric analog resonance, and vice versa.

6. In regions of nuclear deformation, the Nilsson model can be used to limit the possible spins and parities.

7. Statements similar to 4 and 6 based on other models.

8. Statements based on interpolation or extrapolation of regional trends.

9. All statements connected with the nonobservation of expected transitions.

REFERENCES

73Ra10 S. Raman N. B. Gove, *Phys. Rev.* C7, 1995 (1973); Rules for Spin and Parity Assignments Based on Log *f*t Values.

79 En04 P. M. Endt, *At.Data Nucl.Data Tables* 23, 547 (1979); Strengths of Gamma-Ray Transitions in A = 45-90 Nucle.

81En06 P. M. Endt, *At.Data Nucl.Data Tables* 26, 47 (1981); Strengths of Gamma-Ray Transitions in A = 91-150 Nuclei.

CONVENTIONS USED IN NUCLEAR DATA SHEETS

Units

Energies .... keV
Cross Sections .... barns
Magnetic dipole moments .... nuclear magnetons
Electric quadrupole moments .. barns

Uncertainties ("Errors") The uncertainty in any number is given one space after the number itself:

4.623 *3*	means 4.623 ±0.003
4.6 *12*	means 4.6 ±1.2
5.4×10^3 *2*	means 5400 ±200
4.2 +*8-10*	means $4.2^{+0.8}_{-1.0}$
–4.2 +*8-10*	means –(4.2 +10–8) = $-4.2^{+0.8}_{-1.0}$

? Question marks given after the energy value of a level or a radiation represent doubt as to the existence of that level or the radiation. A "?" given after the $T_{1/2}$ value indicates that the assignment of that half-life to the given level is not certain.

( ) Parentheses have the following interpretation for different quantities in the tabular data:

Quantity	Meaning of Parentheses
J^π	J^π based upon weak arguments
L,Mult.	Probable but not definite
Other	Value deduced (not directly measured) or taken from other experiment(s).

Examples:

J^π=(1/2,3/2)$^-$
Weak arguments limit the spin to 1/2 or 3/2. Strong arguments indicate negative parity.

J^π=4 $^{(+)}$
Strong arguments show the spin is 4; weak rguments suggest positive parity.

Mult.=M1(+E2)
Multipolarity is M1 with possible admixture of E2.

[ ] Brackets

7/2$^-$[514] Nilsson asymptotic quantum numbers, $K^\pi[N\ n_Z\ \Lambda]$
Assumed quantity, e.g., [M1+E2], [7/2+]

XREF (Cross Reference)
The cross reference symbols (characters 'A' to 'O') for the various experiments in which a level is seen are sometimes given in the adopted-levels table. When an adopted level may correspond to more than one level in a given experiment the flag for that experiment is given in lower case. In cases of ambiguity the energy for the corresponding level is given as a comment.

Level Scheme Symbols

File Name : fig2.p
Title : ENSDF APP
CreationDate : 1

Level of which the existence is not well-established

Adopted position of neutron- or proton-separation energy

Well-established level

Ground-state or long-lived isomeric level

Radiation of which the positio on the level scheme is not well-established

An expected strong transition that has not been observed

Beta, gamma, and alpha ray placement is consistent with coincidence measurements

4380 0.4 7.5

4380-keV α-transition with intensity 0 4% and hindrance factor (HF) = 7.5

Decay modes of a level

404 4 8.5

β^--transition with endpoint energy, 404 keV measured directly; intensity, 4% of decays, usually found indirectly (from γ-intensities, a more accurate method if there are several β-groups); log *ft*=8.5

119 80 6.3

ε∠transition with energy determined directly from endpoint of γ-continuum (to which is added K-shell electron binding energy) or from L-, K-capture ratio; with intensity 80%, usually determined indirectly (from γ-intensities); log *ft*=6.3

665 25

γ-–transition with energy 665 keV and intensity 25 in the units specified in the drawing

Number per 100 disintegration of a nuclear level

APPENDIX F-5

Nuclear Data Sheets Symbols and Abbreviations

A	mass number*, A=Z+N
A_2, A_4	coefficients of Legendre polynomials in angular-correlation or angular-distribution measurement
av	average
B(EL), B(ML)	reduced EL, ML transition probability in $e^2 \bullet (\mathrm{barn})^L$, $\mu_N^2 \bullet (\mathrm{barn})^{L-1}$
calc, CA	calculated, calculation
CCBA	coupled-channel Born approximation
c e	conversion electron
chem	chemical separation
circ	circular
c.m.	center of mass
coef	coefficient
coin	coincidence
Coul. ex.	Coulomb excitation
CP	circular polarization
cryst	crystal diffraction spectrometer
C^2S, C^2S'	one- nucleon spectroscopic strength for pickup, stripping reactions
d	day
D	dipole
DSA	Doppler shift attenuation
DWBA	distorted-wave Born approximation
DWIA	distorted-wave impulse approximation
E	energy
E(ε)	energy of electron-capture transition (endpoint of γ-continuum + K-electron separation energy of daughter)
E1, E2, EL	electric dipole, quadrupole, 2^L-pole
excit	excitation function
expt	experiment, experimental
F	fission
F-K	Fermi-Kurie (plot)
FWHM	energy resolution, full width at half maximum
g	gyromagnetic ratio*
GDR	giant dipole resonance
GQR	giant quadrupole resonance
g.s.	ground state
h	hour
H	magnetic field
HF	hindrance factor
hfs	hyperfine structure
HI	heavy ion
I	intensity
IAR	isobaric analog resonance
IAS	isobaric analog state
IBS	internal brehmsstrahlung spectrum
IMPAC	ion implantation perturbed angular correlation technique
inel	inelastic
ion chem	chemical separation by ion exchange
IT	isomeric transition

J	total angular momentum quantum number*
K	projection of nuclear angular momentum J on nuclear symmetry axis
K, L, M	K–, L– M-shell internal conversion
K/L	K–, L–conversion electron ratio
L	(1)orbital angular momentum quantum number*, (2)multipolarity
L(n), L(p)	L–transfer in neutron, proton transfer reaction
min	minute
M+	M+N+O+…
M1, M2, ML	magnetic dipole, quadrupole, 2^L-pole
mag spect	magnetic spectrometer
max	maximum
Moss	Mossbauer effect
ms	(1)mass spectrometer, (2)millisecond
mult	multipolarity/character
N	neutron number*, N=A-Z
NMR, NQR	nuclear magnetic, quadrupole resonance
norm	normalization
PAC	perturbed angular correlation
pc	proportional counter
p,γ(θ)	angular distribution of γ-rays with respect to a proton beam
p,γ(t)	time distribution of photons with respect to a pulsed proton beam
pol	polarized, polarization
priv comm	private communication
PWBA	plane-wave Born approximation
Q	(1) reaction energy*, (2) disintegration energy*, (3)quadrupole moment*, in units of barns, (4)quadrupole
Q(ε)	total disintegration energy in ε decay
$Q(\beta^-)$	total disintregation energy in β^- decay
Q(α)	total disintegration energy in α decay E(α) + E(recoil)
R	$r_0A^{1/3}$, nuclear radius*
RDM	recoil distance measurement
RUL	recommended upper limit for γ-ray strength
rel	relative
res	resonance
s	second
S	spectroscopic factor
S'	$[(2J_f+1) / 2J_i+1)]S$
S(n) or S_n, S(p) or S_p,	energy necessary to separate a neutron, proton from nucleus
scatt	scattering
scin	scintillation counter
semi	semiconductor detector
SF	spontaneous fission
spall	spallation
sr	steradian
syst, SY	systematics

Nuclear Data Sheets Symbols and Abbreviations (cont'd)

t	triton
T	(1)isobaric spin, (2)temperature
T_Z	Z-Component of isobaric spin, (N-Z)/2
$T_{1/2}$	half-life*
th	thermal
thresh	threshold
tof	time-of-flight measurement
vib	vibrational
W.u.	Weisskopf single-particle transition speed
y	year
Z	atomic number*, Z=A-N
α	total γ-ray internal conversion coefficient N(ce)/N(γ)*
α(K), α(L)	γ-ray internal conversion coefficient for electrons ejected from the K–, L—shell
αγ, βγ, γγ	coincidences of α's and γ's, β's and γ's, and γ's and γ's
αγ(θ,H,t), βγ(θ,H,t), γγ(θ,H,t)	αγ–, βγ–, γγ– coincidences as functions of angle, magnetic field, time
β_2, β_3, β_L	quadrupole, octupole, 2^L-pole nuclear deformation parameter
βγ(pol), γγ(pol)	polarization correlation of γ's in coincidence with β's, γ's
Γ, Γ(γ), Γ(n)	level width*, partial width for γ-, n-emission
γ(θ,H,T)	γ-intensity as function of angle,
$\gamma^{\pm}$	annihilation radiation
δ	ratio of reduced matrix elements of (L+1)– to L–pole radiation with sign convention of Krane and Steffen, *Phys.Rev.* C2, 724 (1970)
ε	electron capture
εK, εL, εM	electron capture from K–, L–, M–-shell
ε(γ)B(E2), ε(ce)B(E2)	partial B(E2) for pboton, conversion electron detection
θ	indicates angular dependence
λ	(1)projection of particle angular momentum on nuclear symmetry axis, (2)radiation type, e.g., M1, M2…
μ	magnetic moment of particle*, given in nuclear magnetons (μ_n)
ν	neutron shell-model configuration
π	parity, proton shell-model configuration
σ	cross section*
Σ(γγ)	coincidence summing of γ-rays
ω(K), ω(L)	K, average-L fluorescence yield
%α	percent α branching from level
%β–	percent β- branching from level
%β+	percent β+ branching from level
%ε	percent ε branching from level
%IT	percent (γ+ce) branching from level
%SF	percent spontaneous fission from level
$< r^2 >$	root-mean-square of nuclear radius

Prefixes*

T	tera	$(=10^{12})$	m	milli	$(=10^{-3})$
G	giga	$(=10^{9})$	μ	micro	$(=10^{-6})$
M	mega	$(=10^{6})$	n	nano	$(=10^{-9})$
k	kilo	$(=10^{3})$	p	pico	$(=10^{-12})$
c	centi	$(=10^{-2})$	f	femto	$(=10^{-15})$
			a	atto	$(=10^{-18})$

Symbols for Particles and Quanta *

n	neutron	π	pion
p	proton	μ	muon
d	deuteron	e	electron
t	triton	ν	neutrino
α	α-particle	γ	photon

*Recommended by Commission on Symbols, Units, and Nomenclature of International Union of Pure and Applied Physics